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ENGINEERING AND MINING JOURNAL

APRIL, 1942

Iron ore moves down the Lakes again as the 1942 shipping season starts. A carrier at Toledo

In this issue

A MESSAGE to MINE OPERATORS and MANUFACTURERS
From WILBUR A. NELSON
Administrator of the Mining Branch of WPB's Materials Division

Also A Mining Tour of South America—II

Complete Contents on Page 35

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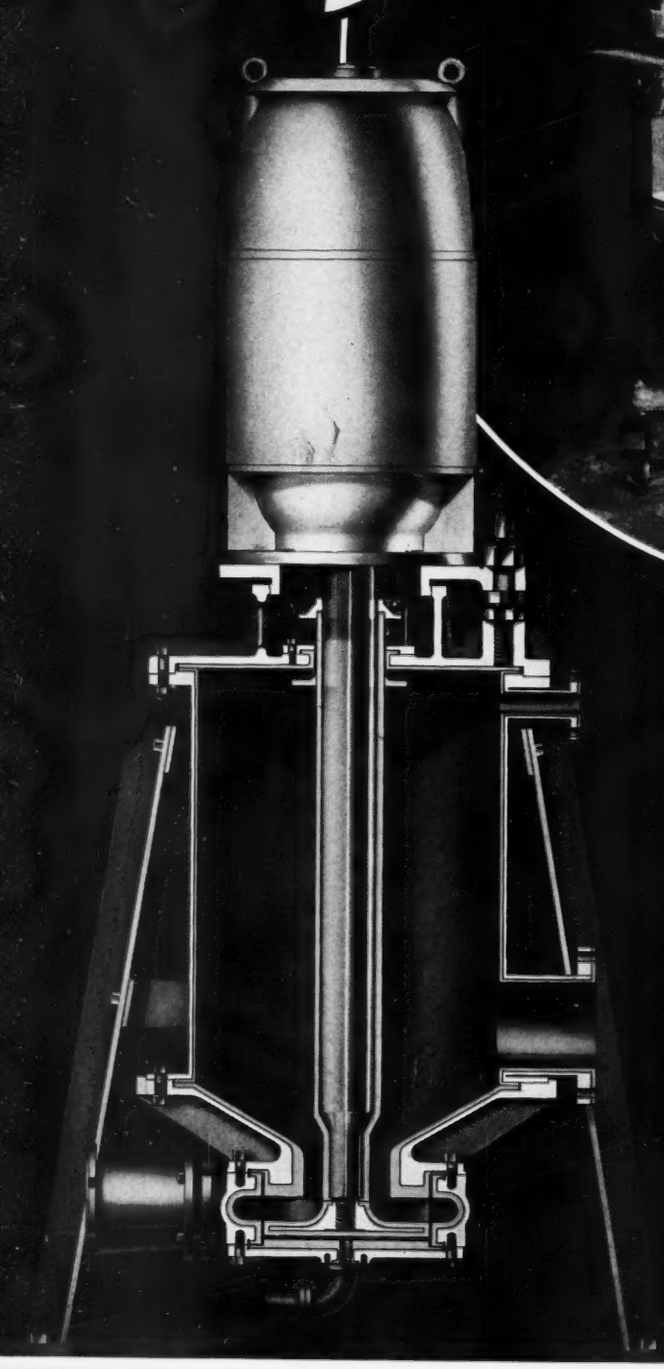

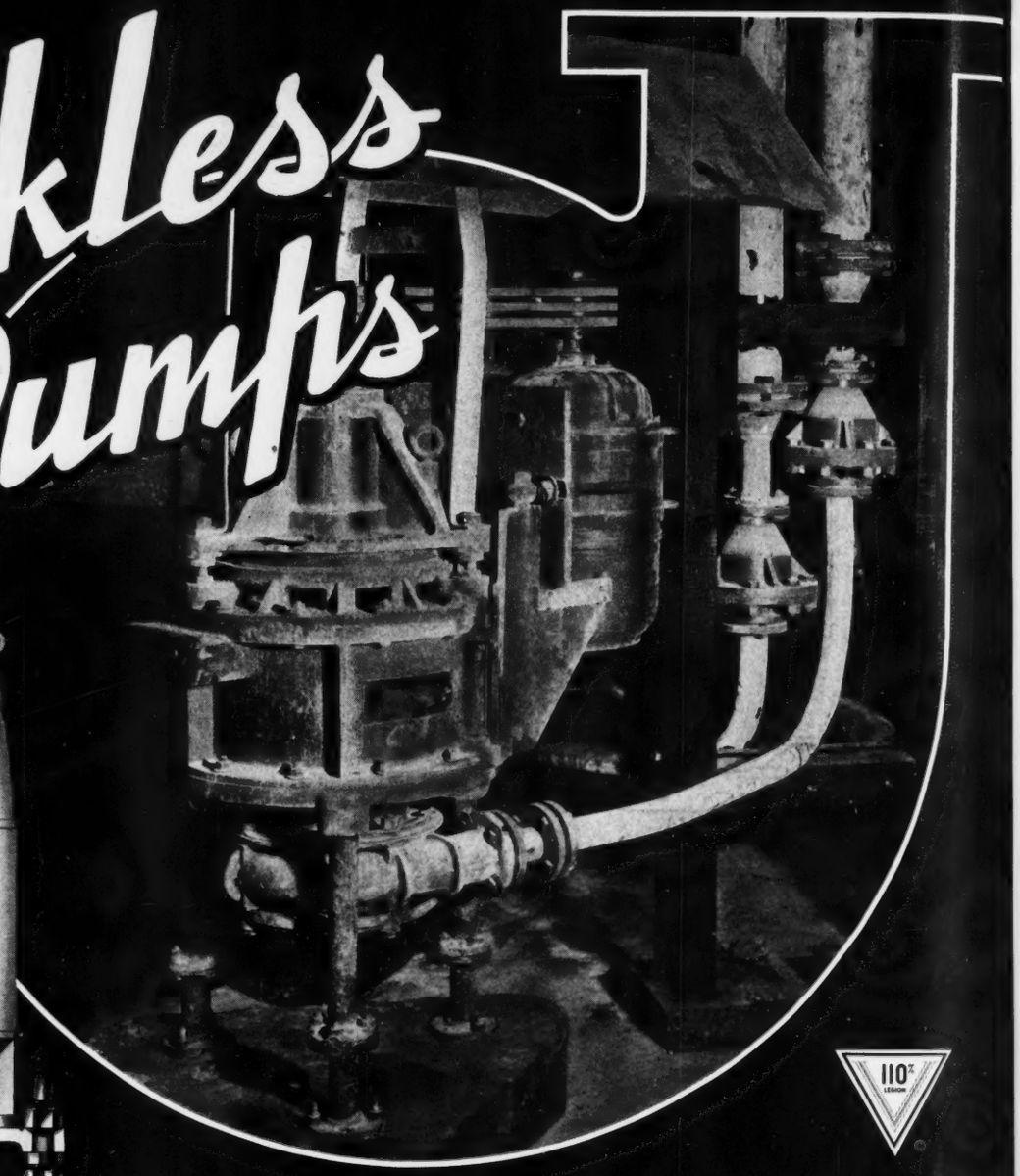

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Change house, or dry, design has improved considerably in the last few years. Once it was enough to provide a room or building, red-hot to dry wet clothes, equipped with shower baths, basins, benches, and lockers to keep a man's possessions safe both when on shift and off. Today more things receive attention, especially dust removal and cleanness. Notable advance was scored a few years back when Oglebay, Norton & Co. put up their model change house at Ramsay, Mich., at the Eureka-Asteroid, on the Gogebic iron range. Today the Menominee boasts a "streamlined" dry, that at Inland Steel Co.'s new Sherwood mine. In layout, equipment, and construction it merits study, as does the entire recently completed plant. R. D. Satterley, superintendent, will describe this newcomer next month.

▼

Grinding, along with milling practice in general, has been undergoing gradual evolution. Outstanding in experimental work have been the plant-scale fine-grinding tests made by Lake Shore, at Kirkland Lake, and reported in a *Bulletin* of the C.I.M.M. 20 months ago. Widely commented upon at the time, this lengthy account probably still awaits the study it deserves in various quarters. Henry Hanson, metallurgical engineer of Toronto, makes it the basis of his comment in an article on grinding progress in Canadian gold plants which will appear in May.

▼

Spain's mineral production, even under the adverse conditions in which its industry finds itself since its Civil War, is sufficiently important to be of interest. C. Sewell Thomas will cover it next month.

▲

Two records, last year's ore shipments down the Lakes and the early getaway of the boats this spring, are harbingers of a third achievement now hoped for—an all-time high in 1942 for iron ore tonnage moved. Preparations over the winter have been most promising.

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

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COVER ILLUSTRATION: Iron ore moves down the Lakes again as the 1942 shipping season starts. A carrier at Toledo. Photo by Ewing Galloway

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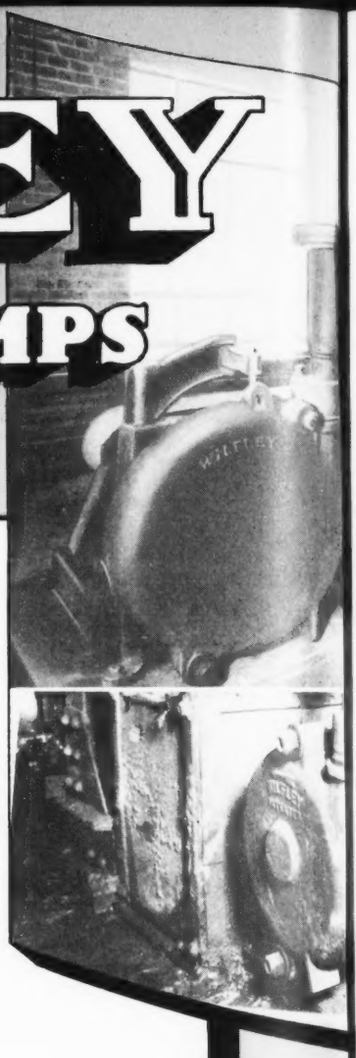

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Volume 143 APRIL, 1942 Number 4

Triple Partnership for Miner, Manufacturer, WPB

Two things stand out crystal-clear as the United States enters the fifth month of the war. First, 1942 will be the critical year for victory. Second, metal and mineral production will be critical items in the war program. Because the mining industry bears this heavy responsibility we asked Wilbur Nelson, Administrator of the Mining Branch, WPB, to address a special message to operators and manufacturers. It is published immediately following these editorial pages, and should be read by everyone connected with the mining industry. (See pages 43-45.)

The burden of Dr. Nelson's story is a plea for cooperation on a scale never before undertaken. He wants to know what the entire mining industry will need in the next year or two in the way of equipment and supplies in order to maintain essential production at the peak of mine capacity. To accomplish this stupendous job he asks all mines to list their needs and pass them on to their supply houses. He asks the latter to summarize the requirements of their customers and give the results to the Mining Branch. From this pool of information, this industry-wide inventory, the Mining Branch will be able to show WPB what raw materials will be needed, and can arrange for their allocation.

We urge one hundred percent response to Dr. Nelson's suggestion. It is the only intelligent procedure that will insure to mining a satisfactory source of equipment and supplies. Other industries are clamoring for steel and for manufacturing capacity. And although the WPB exercises its best judgment in allocating our limited resources, it cannot give mining the consideration to which it is entitled if the basic requirements are not known. The mines *must* play their part in this program or they are likely to find themselves short of equipment and supplies when their metal output is badly needed.

The urgency is no less great for manufacturers, although it can be added that they have cooperated closely with the Mining Branch. Nevertheless there are some laggards, and the picture of raw-material requirements will be distorted to the extent that they do not participate in the pool of information for WPB. Their failure to join in the plan now may disturb mine production later. Success in the end depends on planning and teamwork now.

Another part of Dr. Nelson's message deals with the necessity to conserve mining equipment and supplies for the production of essential war metals. Unfortunately, gold and silver happen to be quite unessential to the war effort, so gold and silver mines may have hard sledding when it comes to maintaining their operations. They will not be wholly deprived of priority status, but will have to content themselves with a rating of A-10 under Order P-100. Some quite important industries are in this class, including public utilities, railroads, and newspapers. So there is no radical discrimination against gold and silver mines. They are asked merely to give precedence to more essential operations. When the details of the plan are understood we doubt if it can be much criticized.

Too Little and Too Late?

If we had our way, every man in the United States would have the duty and privilege tomorrow of listening for five minutes to each of three men on whom rest the heavy responsibilities of fighting this war.

First would be General Marshall, Chief of Staff, United States Army. No industrial leader ever faced a comparable problem of organization and management. Simultaneously he must train raw recruits, organize them into combat units, dilute training personnel almost to the point of weakness, conduct field operations thousands of miles from home, and expand his force ten-fold. The job calls for the performance of miracles.

Then we would visit General Arnold, commanding the Army Air Corps. Here we would learn the vital nature of the air arm in this war; how neither ground nor naval forces have been, or can be, effective without airplane support. And then the dire need of planes would become apparent as we examined a map of the World and observed the scattered bases and long coast lines, and the military operations thousands of miles away. Plane shortage would become painfully evident.

Finally, we would listen to salty Admiral Land, of the War Shipping Board. And if previously we had thought that General Marshall and General Arnold had critical problems, we would now be almost staggered at the magnitude of the Admiral's job, and the absolute necessity of building ships and more ships. For here, at last, we would arrive at the very bottleneck in the war effort. Without ships General Marshall and General Arnold would be impotent. Neither could reach the theaters of war; both would be frustrated. Shipping would suddenly loom up as the vital link in our operations.

And what is it that worries these three men? Production—the possibility that we may produce too little and too late. And why may this happen? Because men's minds and hearts are not yet one hundred percent in the war effort; because they are too much concerned about the forty-hour week, overtime and strikes; about prices and costs; about profits and taxes, salaries and bonuses. With these things filling the news headlines and cluttering up men's minds, they can't concentrate on winning the war by stepping up production of everything from raw materials to finished war machines.

More and more production is the cry of these fighters of whom we are expecting almost the impossible. They know that greater productivity is possible, but only if every man can put his mind and heart into the war. They want distractions removed. They want essential issues squarely faced. They want national policies determined that will settle for the duration all matters pertaining to management and labor. They know that once these things are out of the way men can put their hearts into their daily jobs and increase production.

These three have to fight not only the Japs and the Nazis, but they have to battle inflation, and management, and labor, and untimely litigation, and not least of all, politics, and all the other distractions that prevent this country from making an all-out war effort. The situation cries aloud for leadership. And who is reputedly the President's closest adviser in this hour of extremity? A former social worker and onetime distributor of WPA largesse, Harry Hopkins!

We are for the Marshalls, the Arnolds, the Lands, the Nelsons, the Batts, and all the other realists that are *fighting* this war. And we believe that the hour calls for "tough guys" to back them up. Will they get the necessary administrative and legislative support? Or will history repeat Kipling's ominous

Epitaph 1918

The battery's out of ammunition.
If any mourn us in the shop, say
"We died because the shift kept holiday."

Beat the Promise

There are bright spots in this battle for industrial production, and one of the brightest is the RCA Manufacturing Company. Its "Beat the Promise" campaign has raised morale and enthusiasm, increased production, and turned the tables on "Too little and too late."

More than two years ago RCA realized that it was likely to play an important rôle if and when war came to this country. So plans were laid to enlist the cooperation of thousands of employees. The springboard for the program was an individual pledge not only to meet the requirements of defense production, but to *beat the promise.* Then followed the good old American custom of stimulating the competitive spirit among the company's plants, departments, and personnel. Flags and symbols were awarded, prizes were given. Rallies were held, public-address systems transmitted talks by company officials, union leaders, workers, Army and Navy officers. Posters were printed and songs composed to instill a fighting spirit in the whole force. Interviews with former employees, now soldiers in camp, were recorded and sent back to factories to be repeated over loudspeaker systems.

Results? One Signal Corps order delivered a a year early; another sixteen months ahead of time. More than 36,000 suggestions from employees. Promises beaten on certain defense equipment for thirteen consecutive weeks. Altogether an inspiring performance, and one that can be repeated in any organization in this country that has within its ranks a sparkplug to energize the working force.

Reflections from Washington

By Special Correspondent

A BABEL OF VOICES characterized Washington last month. Much of the confusion came from conflicting interests and efforts of various pressure groups, which, in the absence of authoritative leadership, precipitated controversies that resulted in a stalemate in some activities. The rubber situation best illustrates the way in which this conflict of interest works.

Uncle Sam has a rubber stockpile about equal to the need for a very busy year of peace-time activity. That stockpile plus reclaimed rubber, minor production in Brazil, some from guayule, and much by synthesis will probably satisfy military demand for more than a year.

The synthetic program, therefore, becomes a key to military progress. To carry it forward requires rubber-making chemicals, new plant facilities for synthesizing rubber from these materials, and experience and new skill in the use of synthetic rubber for tires and other essential products.

For raw material we must use sugar or some other fermentable equivalent made from corn, wheat, sorghum, or other source. In effect, Uncle Sam says to the chemical engineer "Here is my sugar bowl and a can of crude oil. Make a million tons a year of synthetic rubber for the tires of my Army and to care for civilian need."

Now enter the conflicting pressure groups. The food industry wants its sugar, so do the housewives. The petroleum industry wants to make the primary chemicals, but is not yet ready. The chemical engineer can make alcohol for butadiene and thus approach synthetic rubber effectively, but to make alcohol, he must have either sugar or molasses or other fermentable carbohydrates. Agriculture would like its surplus wheat and corn used as the raw material. Certain interests would like their molasses to dominate the supply. Different groups in the alcohol industry have different degrees of interest in various raw materials. And other Army and necessary civilian demands have already multiplied industrial alcohol requirements to a point four times normal peace-time use. It requires no second sight to discover in this situation a multiplicity of conflicting interests.

Mine Aid for Brazil

SEVERAL NEW CREDITS have been granted for Brazilian mining enterprise to speed up Hemisphere cooperation. One is a general credit of $100,000,000 from Export-Import Bank, which is intended to assist in the program of mobilizing all of the productive resources of Brazil. It includes not only mineral, but also agricultural and forest developments—for example, rubber.

One specific announcement from Metals Reserve Co. is an agreement to purchase iron ore which will be mined and transported from Itabira region in the State of Minas Geraes. A special grant of $14,000,000 from Export-Import Bank will provide for rehabilitation of the Victoria-Minas Railway, opening up of the iron mines, and provision of ore-loading facilities at the Port of Victoria. Repayment of the loan will be by the ore so delivered to either Metals Reserve Co. or the British Government.

Under the general proposal of credits, it is expected that many projects will be offered for consideration. Acceptance of these under the terms of the loan is "conditioned upon careful investigation and determination that the particular project will contribute . . . to our war effort . . ." After finding the loan so qualified, effort will be made to get priority ratings from W.P.B. for the required new materials and equipment. Thus, a double check on projects under the loan is provided by the separate actions of R.F.C., assisted by the government representatives in South America, and by W.P.B. priority review.

Metals Reserve Commitments

IN A REPORT covering the activities of the Reconstruction Finance Corporation and its subsidiaries, Jesse H. Jones reveals some interesting commitments by the Metals Reserve Co., the Government's ore-buying agency. They now aggregate $2,215,818,000, as follows:

Material	Value
Aluminum	$245,089,000
Antimony	7,053,000
Asbestos	915,000
Bauxite	8,741,000
Beryllium	882,000
Cadmium	194,000
Chrome	31,808,000
Cobalt	60,000
Copper	226,402,000
Diamonds	3,469,000
Graphite	486,000
Iridium	128,000
Iron ore	21,896,000
Lead	117,881,000
Lead ore	6,043,000
Manganese	132,858,000
Mercury	3,277,000
Mica	6,340,000
Molybdenum ore	332,000
Nickel	4,469,000
Platinum metals (crude)	1,292,000
Quartz crystals	3,814,000
Rutile ore	119,000
Speiss	559,000
Tin refined	207,556,000
Tin ore	129,922,000
Tungsten	154,035,000
Zinc	146,570,000
Zinc ore	9,808,000
Brazilian materials	121,000
Chilean materials	12,325,000
Chrome plant commitments	5,724,000
Philippine materials	5,250,000
Nicaro Nickel Co. (stock)	1,100,000
Domestic materials	720,000,000
Total	(a) $2,215,818,000

(a) Includes commitments totaling $38,143,000 which were cancelled, principally due to inability of sellers to deliver.

The foregoing schedule includes a commitment to undertake, in accordance with the request of the War Production Board, a program of converting to war purposes certain types of scarce materials. This includes the acquisition of partly fabricated materials, scrap and obsolete materials, and inactive inventories of aluminum, copper, brass, iron, steel, tin, ferroalloys, and other critical materials and their reduction to usable state for war purposes. It is estimated that the total cost of this program may run as high as $720,000,000 and that there probably will be a loss of at least one-half of this amount in making the materials available to the trade at current ceiling prices.

Strategics Research

TO CONTINUE its investigations during the coming fiscal year, Secretary Ickes has asked for the U. S. Bureau of Mines the following items, which have had Presidential and Budget Bureau approval. These items now are before Congress undergoing appropriation review:

"A supplemental $1,000,000 for the investigation of 'critical and essential minerals in the United States and its possessions.'

"A supplemental $550,000 for magnesium pilot plants and research. Magnesium is one of the lightest metals and its alloys are of vast importance in airplanes, and, therefore, its production is being rapidly stepped up and pilot-plant testing is required immediately.

"A supplemental $75,000 for work on beneficiation of chromite and production of electrolytic chromium. Heretofore chromium, necessary in war both as an alloy and a rust resistant used in naval and army metals, has had negligible domestic production and was obtained chiefly from the Philippines, Africa, and Turkey.

"A supplemental $160,000 for investigation of raw material for Western steel production. Steel used in Western war production must now be shipped over burdened transports from Eastern production which is operating to capacity.

"A supplemental $250,000 for investigating domestic sources of mineral supply without restriction to the categories of 'critical and essential' which change in rating daily.

"In each instance the Bureau of Mines also would be authorized to accept lands, buildings, equipment, and other contributions from public or private sources for the purposes of developing war metals from domestic sources."

Mg via Ferrosilicon

MORE DETAILS of the methods used for making magnesium by the ferrosilicon process have been announced recently. (See *E.&M.J.*, page 33, March, 1942.) Some information has also been released regarding the use of calcium carbide instead of ferrosilicon.

Most completely described by its backers is the Pidgeon process as follows: "The Pidgeon process for the production of metallic magnesium consists essentially in reacting burnt dolomitic lime with crushed ferrosilicon in an externally

heated, sealed, metallic retort, which is kept under vacuum by means of vacuum pumps. The metal, 99.98 percent pure, is recovered in a solid dense crystalline mass, which is subsequently melted down under flux and poured into ingots. The crystalline masses may also be added direct to molten aluminum for the production of aluminum-magnesium alloys."

Variations of the processes to be employed by other companies, including Electro Metallurgical Co., use refractory retort, internal heating, and other important variations of the same fundamental principle. These variations make the process quite different than normal zinc metallurgy, from which much of the Pidgeon process technic has been adapted. It is important to note that all of these processes are of the batch type. But with large retorts which are used by some companies, a very substantial quantity of material can be produced per charge.

Some experiments have been made in the United States on the use of calcium carbide as the reducing agent. No commercialization is yet planned, probably because of the larger power requirement. However, the carbide method is in use in Australia following the developments of Murex, Ltd. That process heats together finely ground carbide with calcined magnesite in a vacuum. The vapor of crude metal is condensed to a solid and then purified by melting under a suitable flux.

Manganese Contracts

CONTRACTS for ten new plants to concentrate manganese from domestic ores were announced early in March by W.P.B. Three large plants will use chemical extraction processes which have been reviewed by the Bureau of Mines and the W.P.B. Advisory Committee. These will work on 10 to 12 percent ore and prepare about 400,000 tons per year of concentrate suitable for ferro-alloy manufacture. They will be located on the Cuyuna Range in Minnesota, in the Chamberlain district of South Dakota, and at one of the Hanna properties in Nevada.

The seven small plants will be ore-dressing units taking local low-grade ores for beneficiation. In the aggregate, these plants will, it is hoped, prepare about 200,000 tons per year of concentrate suitable for alloy manufacture in a blast furnace. The plants will be in Arkansas, Montana, Nevada, Utah, Georgia, and Tennessee (two plants).

This program will not in any way interfere with the continuing effort to secure maximum import of high-grade manganese ores.

Corporate Data Required

WHEN ANY CORPORATION applies for a license for explosives handling or use, it is now required under modified regulations to give the most intimate detail of its ownership. Thus, "applications of corporations . . . shall show the following:

"The name, address, and nationality of all officers, directors, trustees, or persons exercising similar functions.

"The name, address, nationality, and the extent of interest in the voting stock or other beneficial voting holdings of the stockholders or members, beginning with the holder of the largest voting interest, and continuing in the order of the amount of the respective diminishing voting holdings, until not less than 51 percent of all voting stock or other beneficial voting holding is shown: Provided, That not more than ten need be listed. If those listed do not hold 51 percent or more of the stock or other beneficial voting holdings, then the application must be supported by the affidavit of the applicant, which may be stated on belief and the best information available, stating the nationality of the majority of the stockholders or members. The nationality of any corporation or organization listed in the application as a stockholder or member shall be given as the place of incorporation or organization:

"In any case where a corporation owns more than 50 percent of the stock of the applicant, the applicant must also list the name, address, and nationality of the officers and directors of that corporation.

News "Fines"

Imported Strategics—Elaborate rules for control and ownership of imported strategic materials were issued formally on March 17 by publication in the Federal Register. Without authorization, no private enterprise can longer control imports of antimony or asbestos originating in Rhodesia or the Union of South Africa, chromium, copper, graphite or plumbago, either crystalline or flake, kyanite or sillimanite, mica, rutile, tungsten, vanadium, zinc, or zirconium.

Prospectors Stimulated—Interior Department officials held pep meetings for prospectors throughout the Western states during March to stress the need for strategic and deficient materials for which immediate prospecting is desired, including copper, zinc, lead, vanadium, tungsten, bauxite, alunite, and alluminum clays, as well as other deficient minerals. The press announcements of the Department implied that this kind of prospecting discovered the great low-grade manganese deposits of Minnesota, Nevada, and South Dakota which are now being developed by the Department.

Hemisphere Aids — During the first three months of 1942 the United States allocated to Latin American republics large quantities of scarce materials, including 375,000 tons of steel, 3,300,000 lb. of rayon, $13,000,000 in miscellaneous farm machinery, 10,100,000 lb. of ammonium sulphate, 35,000,000 lb. of caustic soda, 17,500,000 lb. of copper sulphate, 47,500,000 lb. of soda ash, 17,500,000 lb. of superphosphate. "Glycerine, citric acid, chlorine, nickel, platinum, plastics, tungsten, formaldehyde, and other items—all considered by production officials as materials most in demand for war industry—are on the list of goods allotted to sister American republics."

Bonneville Industry—Power contracts have been announced by Bonneville Power Administrator for several additional defense metal plants. The largest recent announcement was a contract for 97,500 kw. of firm power for Alcoa to use at Troutdale in the large aluminum reduction plant there. Other contracts forecast were for aluminum ingot, aluminum fabrication, magnesium, ferro-silicon, TNT, phosphorus, and other war chemical production. A total of 56 power contracts thus far granted provide commitments of over 425,000 kw. Contracts under active negotiation will raise the total to 875,000 kw.

Chrome Purchases — During March, Metals Reserve Co. began receiving chrome ore deliveries from small producers in Oregon and northern California. It announced at the end of February that it would buy from such producers in truckload lots through agencies stationed at Coquille, Grants Pass, and Seneca, Oregon, and Yreka, Calif.

Use More Coal!—Vigorous effort is being made by the Petroleum Coordinator to force industrial users of oil for heat or power to change their operations to a coal basis wherever possible. Tanker sinkings have placed a new transport load on the tank cars available beyond any possibility of meeting total needs next winter. Immediate shift from liquid to solid fuel is, therefore, urged for all points not close to oil-producing areas.

Loss of Explosives—If any explosives, or ingredients for which license is required to make a purchase, are lost or stolen, the owner must immediately report this fact to the U. S. Bureau of Mines. Investigations of the Bureau and F.B.I. will aid in the effort to apprehend those guilty. Companies which do not keep close records and promptly report losses may be subject to suspension of license. The government holds any licensee, whether corporate or individual, responsible for great care in preventing diversion of such materials, especially where sabotage may result.

Freight Rate Increases—The railroads were granted by I.C.C. only a 6 percent general freight rate increase on most commodities. And the low-grade mine products, such as sand, gravel, phosphate rock, bentonite, kaolin, feldspar, limestone, crushed stone, and slag, will bear only a 3 percent increase. Coal and coke rates were modified by fixed amounts. It is argued that some of the ore-carrying roads are the most profitable of the country and should not be granted a blanket general increase comparable with others. For this reason, iron ore and iron sinter were not granted any rate increase.

Negotiated Contracts—On March 4, W.P.B. Chairman Nelson ordered that further war contracts on all military supplies be negotiated rather than placed by competitive bids. Preference is to be given to bidders who offer the maximum speed of delivery rather than those offering the lowest price. Small firms able to make satisfactory deliveries of simple standard materials are to get preference so that facilities of big concerns can be reserved for more complicated and difficult items. Subject to these restrictions, preference is always to be given to a concern which can make the desired delivery with a minimum requirement of new machinery or equipment.

Cuban Nickel—Simultaneous announcement was made March 18 by Defense Plant Corp. in Washington and Freeport Sulphur Co., New York, of plans of Nicaro Nickel Co., a Freeport subsidiary, to build a $20,000,000 plant for the development of extensive low-grade nickel

(*Continued on page* 109)

A MESSAGE to

Mine Operators and Manufacturers of Mining Machinery and Supplies

Wilbur A. Nelson, *Administrator, Mining Branch, Materials Division, War Production Board, Washington, D. C.*

IN SETTING UP the Mining Branch of the Materials Division of the War Production Board, clear recognition was given to the fact that mining is Number One War Industry and that certain metals and nonmetallic minerals are prime essentials to a military victory. No other industry rivals mining in the essential character of its products, nor can any other industry make its full contribution to the war without them. Planes, tanks, guns, ships, and all the implements and instruments of modern mechanized warfare call for metals in ever-increasing quantities. The essential character of these raw materials is axiomatic.

To the mining industry this is at once a matter of pride and responsibility. The very importance of the industry entails an equal measure of obligation to see that minerals are produced in quantity—and in time—to insure victory. The need was never so critical; the time was never so short. As President Roosevelt has so well said: *"Never before have we had so little time in which to do so much."* A heavy duty and responsibility, therefore, rests upon us who are associated in the mining industry to join forces so that maximum production will be made in minimum time.

This will call for extreme measures of cooperation to which we are not accustomed in normal times. It will entail sacrifice of self-interest and dislocation of customary routine. But ordinary procedures will not meet the emergencies of extraordinary times, so we must coordinate closely the efforts of all elements of the industry if we are to function effectively. Mine operators, manufacturers, and the Mining Branch of WPB must unite in a determined effort to reach the goals set up for our armed forces.

As Administrator of the Mining Branch I have felt for some time that, in establishing preference ratings, mine operators and makers of mining machinery should be placed on a parity with makers of munitions. Recent amendments to Preference Rating Orders P-56 and P-56-a for mine operators and manufacturers of mining machinery, respectively, implement that policy. They give to those two important groups high ratings for essential repair parts, and provide for delivery of essential new machinery and equipment on advance application. Together with Preference Rating Order P-73 for smelters and refiners of essential metals they provide for the requirements of the mining industry from prospecting to production of metal.

But preference rating orders alone will not accomplish all that is desired. We must enlist the self-interest of operators and machinery makers if we are to insure adequate supplies of repair parts and raw materials. *The requirements of operators and manufacturers must be inventoried and known far in advance if raw materials are to be earmarked and allocated for their use.* Take a quick glance at the cold logic of the situation, and note the inevitable conclusion.

1. Minerals are prime essentials in this war. They must be produced in ever greater quantities.
2. This means double- and triple-shift days, and six- and seven-day weeks.
3. Increased hours of operation add to the wear and tear of machinery, call for more repair parts, and ultimately for new equipment.
4. Manufacturers and suppliers cannot meet this abnormal demand unless (a) they have in advance a pretty fair idea of its magnitude, and (b) assurance of adequate supplies of critical raw materials for fabrication.
5. The mine operator holds an important key to the situation. He alone can make a fair estimate of his own requirements under current operating conditions.
6. The War Production Board holds the critical key; namely, the power to earmark for use by manufacturers the necessary quantities of raw materials, once the primary information has been supplied by operators. The Mining Branch is using all of its energies to see that this is done.
7. The inevitable conclusion is that operators must inventory their needs by quarters for the remainder of 1942 and early 1943 and notify their customary suppliers of their probable requirements. Being thus forearmed, manufacturers should inform the Mining Branch of their needs. The requisite quantities of raw materials can then be earmarked for future use. Only in this manner, and with the closest cooperation, can any reasonable estimate be made that will

***THE ADMINISTRATOR** of the Mining Branch, Materials Division, War Production Board, rates mining on a parity with the manufacture of munitions, and obtains high priorities for repairs and supplies. He asks operators and manufacturers to inventory their equipment and raw material requirements for the remainder of 1942 so that essential metal production will continue uninterrupted at maximum rate. Complex ore mines, which produce amounts of copper, lead, or zinc needed in the War Effort, will continue to receive the priority benefits of Preference Rating Order P-56, irrespective of the amount of gold or silver produced. The same will be true for mines producing siliceous ores necessary for the continued operation of smelters.*

insure continuous mine operation at the peak of production.

Another obvious duty remains to manufacturers in the interest of conservation and economy, and that is to simplify their lines of products, abandoning non-essential styles, sizes, and varieties, and concentrating their production effort on the most essential. The opportunity for simplification probably is not as great in the field of mining equipment and supplies as in some other lines of manufacture, but the possible economies should not be overlooked. Now is a good time to clean house and notify the mining industry of your decision.

It is impossible to overestimate the importance of this matter of coordinating the activities of the mine operator, the equipment manufacturer, and the Mining Branch of WPB if mining is to make its vital contribution to the war effort. I can assure all concerned that the Mining Branch will exercise its power and authority in the interest of maximum production of essential metals and non-metallic minerals; but we can be effective only if operators take the trouble to tell manufacturers what they need. Most of the latter have already informed the Mining Branch of their requirements.

Probably a further word is needed at this time in explanation of the amendments to Preference Rating Orders P-56 and P-56-a. The principal changes are to the following effect.

Complex ore mines, which produce amounts of copper, lead, or zinc needed in the War Effort, will continue to receive the priority benefits of Preference Rating Order P-56, irrespective of the amount of gold or silver produced. The same will be true for mines producing siliceous ores necessary for the continued operation of smelters.

The A-1-a rating for repair of actual breakdowns is continued in effect. It can be applied only after advance approval by the Director of Industry Operations.

An A-1-c rating is given to deliveries to essential mines of repair parts for essential machines. An operator is restricted in applying this rating to a quota established quarterly by the Director of Industry Operations.

An A-1-c rating is given to deliveries of other repair parts and to other mines when necessary to avert breakdowns. This rating can be applied only after advance approval by the Director of Industry Operations.

Deliveries of essential machinery and equipment receive such preference ratings as may be assigned by the Director of Industry Operations after advance applications.

Suppliers can extend at the same level the ratings received from operators.

The exclusion of gold and silver mines from the benefits of P-56 was naturally the cause of some disturbance and misunderstanding in the industry. In an effort to clarify the situation I made public a statement substantially as follows:

"No mines producing copper, lead, or zinc in amounts needed in our War Effort, irrespective of the amounts of gold or silver produced by such mines, will be denied priority ratings under Order P-56. Each case will be reviewed and where it is found that the mine is producing needed amounts of copper, lead, or zinc, that mine's serial number will be reinstated. This will also apply to mines producing siliceous ores where such ores are needed by a smelter in order to maintain the smelter's production of copper and lead.

"We have already reinstated the serial numbers of certain mines, and will complete this reinstatement as promptly as individual mines furnish us the needed information. Only about three hundred mines were notified by wire that their serial numbers under Order P-56 had been withdrawn. May I point out that these mines still had the priority rating of A-10 under P-100, and that the mine operator could also use our PD-1A forms to apply for preference ratings on specific items from specific suppliers where such items could not be obtained on an A-10 rating.

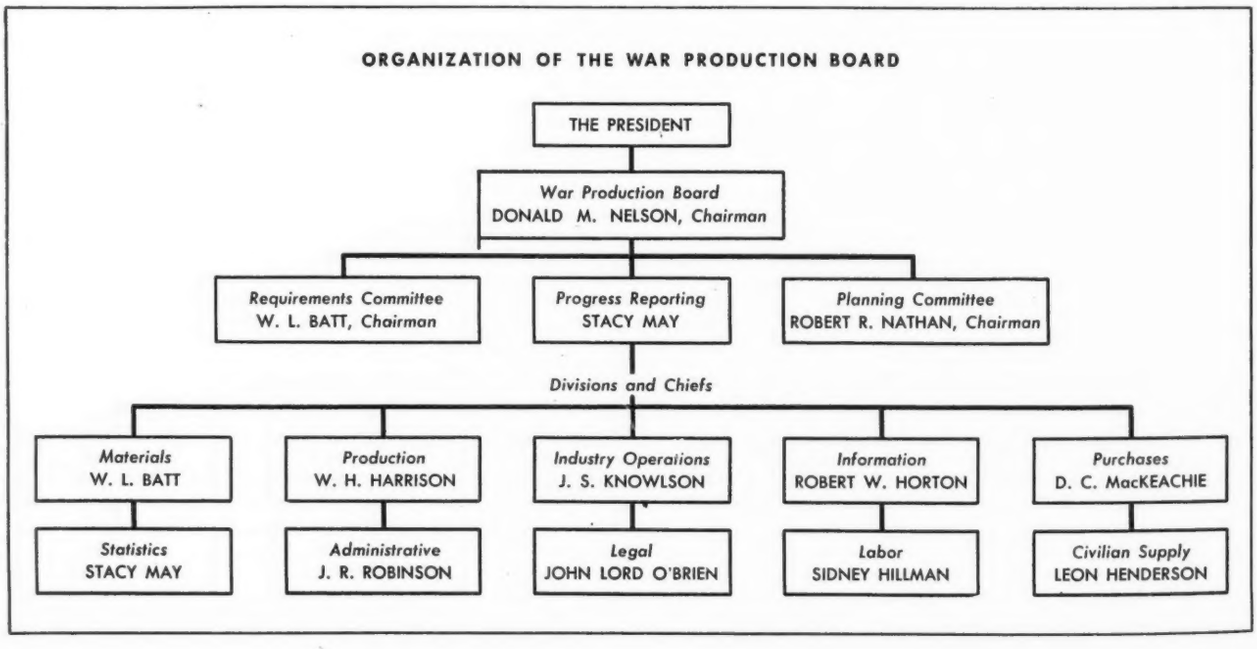
"May I also say that all public utilities, railroads, and newspapers are operating on an A-10 rating at this time.

"If there were no shortage of mining machinery, there would be no need to take any action in regard to mines producing nothing but gold and silver; but with such a shortage, and with the great demands on our country to produce the essential and strategic minerals for the building of the implements of warfare for us and for many of our Allies, we must know that each mining machine is going to a mine which is part of our direct War Effort."

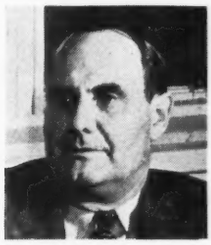
In a further effort to promote a clear understanding of the withdrawal of serial numbers from gold and silver mines, I held an informal conference in Washington with members of Congress representing Western mining States. Subsequently I met with operators and public officials in Reno, Nevada, and Denver, Colorado, where I explained the urgency of the situation and the necessity for conserving materials and supplies for production of critical and essential metals.

As a result of the conference and meetings I feel quite sure that after the operators have responded to my request for information and have been classified on the basis of their production of gold and silver and base metals, they will realize that no injustice was intended and that the amended order was necessary to conserve scarce materials.

In conclusion I reiterate the desire and intent of the Mining Branch to be helpful to operators and manufacturers; but again I emphasize the point that their hearty cooperation is imperative if the War Production Board is to carry out the Victory Program.



MATERIALS DIVISION, WPB



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TIN, LEAD, LEAD ORE

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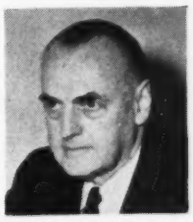

ERWIN VOGELSANG,
Chief
S. K. Butterworth,
Deputy

MISCELLANEOUS MINERALS*

RICHARD J. LUND,
Chief
Roland Parks
Deputy

CORK-ASBESTOS

F. W. GARDNER, Chief

MICA-GRAPHITE

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*Quartz crystals, Radium, Uranium, Kyanite, Diamond dies, Industrial diamonds, Platinum group metals, Mercury, Jewel bearings, Bismuth, Monazite sand, Talc, Feldspar, Topaz, Barite, Arsenic, Abrasives, Diatomaceous earth, chalk

Morro da Mina manganese mine, near Lafayette, Minas Geraes. The operator is Cia. Meridional de Mineracao, a subsidiary of U. S. Steel Corporation

A Mining Tour Through South America

John B. Huttl
Assistant Editor

II—Some Brazilian mines in Bello Horizonte . . . Buenos Aires and the Argentine . . . Braden Copper's operations in Chile

OURO PRETO is a charming old city, one of the oldest in Brazil. It derived its name from the "dark gold" (gold nuggets covered with iron oxide) found by the early miners in nearby streams. The chief attractions are its quaint buildings, and the School of Mines housed in the old governor's palace. The surrounding hills are pock-marked with old mine workings, but mines now active are few. These include the Passagem gold mine, 4 km. from the city, and the pyrite mines operated by Impresa Mineira de Pyrita, Ltd., Washington Dias, director, and Orlando Caldeira, general manager; Sociedade Pyrita Brasil, Ltd., Amadeo Barbosa, director; and Pyrita Piquete, Ltd., operated by the Brazilian Army. Julio Mourao Guimaraes, director, and Oscar Salgado, superintendent, run the Passagem mine, of Cia. Minas da Passagem, a Brazilian enterprise.

I received a splendid reception at the School of Mines, where I had interesting talks with Drs. Sylvio Barbosa, Francisco de Assis Magalhaes Gomes, J. Felippe Santa Cecilia, and others. The school was founded by a Frenchman, and his influence is still felt. A competent faculty is available, but very few students are enrolled. Because of this the cost of graduating a student is about five times higher than at other schools. Ouro Preto is too isolated and quiet to attract young students, I was told. The different laboratories are well equipped, though some of the test units are of somewhat ancient vintage.

In the afternoon Dr. Barbosa and I visited the pyrite mines near the city and the Passagem mine. The largest pyrite operation is that of Impresa Mineira de Pyrita, Ltd., followed by that of Sociedade Pyrita Brasil, Ltd., about 500 m. distant. Tonnages handled respectively are 500 and 200. The third mine, operated by the Army, is inefficiently worked, and daily output is only 100 tons.

A brief description of the Impresa Mineira property may be of interest, for the mill is equipped with American machinery, mostly from the Denver Equipment Co., and is now being enlarged to 1,200 tons.

As to geology, the deposit appears to be an impregnation in the rocks of the center horizon of the "Minas" series composed of graphitic phyllites, phyllites, dolomitic limestone, and *canga*, a limonite conglomerate. The orebody dips at an angle of 45 deg., and strikes 60 deg. N. W. It is worked by open-pit methods with manual labor. However, a ¾-cu.yd., 20B Bucyrus-Erie diesel shovel is available for removing heavy overburden. Hydraulick stripping is being considered. The ore sent to the washing plant in hand-trammed, side-dump cars contains about 15 percent pyrites (by weight), which is raised by washing and concentration to 48 percent sulphur. At the mill the contents of the 1-cu.m. cars are dumped over a grizzly, spaced 6 in., with the undersize passing successively through a primary jaw crusher, Telsmith washer, secondary jaw crusher, sluice, Denver duplex jig, vibrating screen, Telsmith log washer, Leahy vibrating screen, and rolls, before going to the 200-ton bin. Grinding to 90 percent minus 20 mesh is done in a Denver ball mill in closed circuit with a Telsmith sand classifier, with a Denver jig between the two units. Classifier overflow goes to a dewatering cone, the sands flowing to five-spigot hydraulic classifiers feeding four Wilfley sand tables and a Denver jig. Table middlings are re-treated in Denver jigs. Undersize from the two vibrating screens is treated in jigs of the same make, the overflow going to three Wilfley slime tables. Jig and table concentrates go to three dewatering bins, then by car to five 30-ton storage bins. The plant was designed by Dr. Sylvio Barbosa, consulting engineer both to Impresa Mineira de Pyrita, Ltd., and to Sociedade Pyrita Brasil, Ltd.

The Passagem gold mine is about 4 mi. east of Ouro Preto. The company also operates the Santana mine near the Passagem. Production is approximately 300 tons. It ranks second in Brazil in importance, and, like Morro Velho, is very old. Mining dates back to 1817. The present owners acquired the property in 1930 from an English concern which had operated the mine since about 1880 until a few years before the sale, and introduced improvements in mining and milling methods, together with an exploration campaign that led to discovery of new ore.

The country rocks consist of phyllites and quartzites overlain by itabirite, a rock consisting of alternating laminæ of specular hematite and fine quartzite. The ore is found at the contact of dolomitic schist and itabirite, and usually dips southeast at varying angles; in most places 15 to 30 deg. There are two kinds of lodes. Close to the contact are the white lodes, consisting mainly of a white quartz gangue; below these are the black lodes containing principally tourmaline. Recently a third lode was found on the hanging wall, and encouraging results have been obtained from exploratory work. The white lodes are practically continuous and lie in the dolomitic schist. Gold is irregularly distributed throughout the quartz, occurring in dark streaks

or patches associated with tourmaline, pyrrhotite, and arsenopyrite. The latter contains most of the gold as at Morro Velho and Juca Vieira. The black lodes consist mainly of black tourmaline, pyrrhotite, and arsenopyrite, with some quartz. These are smaller than the white lodes, which vary in width up to 36 ft., but are much richer. They are seldom more than 3 ft. in width. In places the two lodes are in contact, but in most instances several feet of barren quartz separate them. The expense involved in searching for the black lodes, and their small size, decrease their importance.

The mine is opened by three 35-deg. incline shafts, which follow the ore to a depth of 3,000 ft. The ore, averaging 6 gr. of gold, is mined by cut-and-fill stoping. Milling practice follows closely that of the other gold mines in the area. It includes two-stage crushing, grinding, concentration on jigs and tables, and cyaniding resultant concentrates. There is also a furnace for the recovery of arsenic.

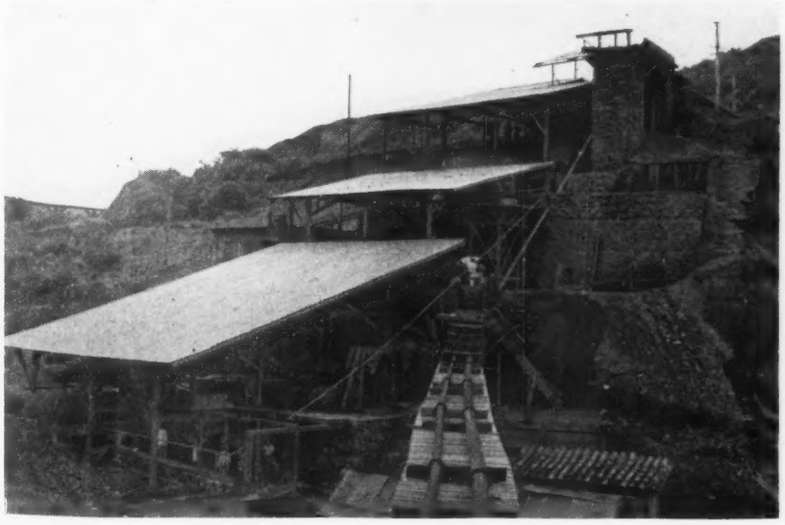
We left Ouro Preto for Burnier on the train around 6 p.m., and upon arrival drove by car to Lafayette. Next morning we visited the manganese mine of Cia. Meridional de Mineração (U. S. Steel subsidiary) about 4 km. from town. Here, Serafin Lana, the Brazilian edition of a Cornish miner, took us around. He functions as local manager, has been at the property for more than 40 years, and certainly keeps things humming. The company has gone in strong for social improvements, and all the workmen have to do is to show up at the mine and put in their required shift. There are good houses, with gardens, playgrounds, a school, a hospital where treatment is given free, and an attractive guest house on a small hill overlooking the village. The mine is well laid out, every man seems to know what he is doing, and there is a safety program patterned after United States practice.

Of the six manganese deposits available, four are under active exploitation by open-pit methods. The orebodies, known as No. 2 and No. 3, furnish most of the output. All pit work—that is, drilling, loading, and tramming—is done by hand. The deposits are irregular in shape and size and occur in altered schistose rocks, with almost vertical dips, and follow the trend of these stratified beds. Shipping ore assays from 46 to 48 percent manganese, and tonnage to be produced in 1942 is 240,000. Some production is derived from washing material taken from old dumps in a 60-ton treatment plant. An additional 100-ton unit is to be installed soon. Treatment involves washing in a trommel and concentration in a vibrating concentrator developed locally. This unit consists of shaking troughs on a steel frame, with flexible wood supports tipped back 15 deg., which shakes at 320 r.p.m. The stroke is $1\frac{3}{4}$ in. The strong spray of water at the discharge end of each trough gives an additional washing to the trommel product, with the heavier particles rising against it and the lighter material being washed down and out of the trough by the water current. Three products are being made—namely, coarse, middling, and fines. The last, being of lower grade, are stockpiled. The coarse product and middlings are loaded into side-dump cars with perforated bottoms and dumped into loading bins. All ore produced at the Morro da Mina property is transported by rail to Rio de Janeiro for shipment to the United States. About 1,000 workers are employed.

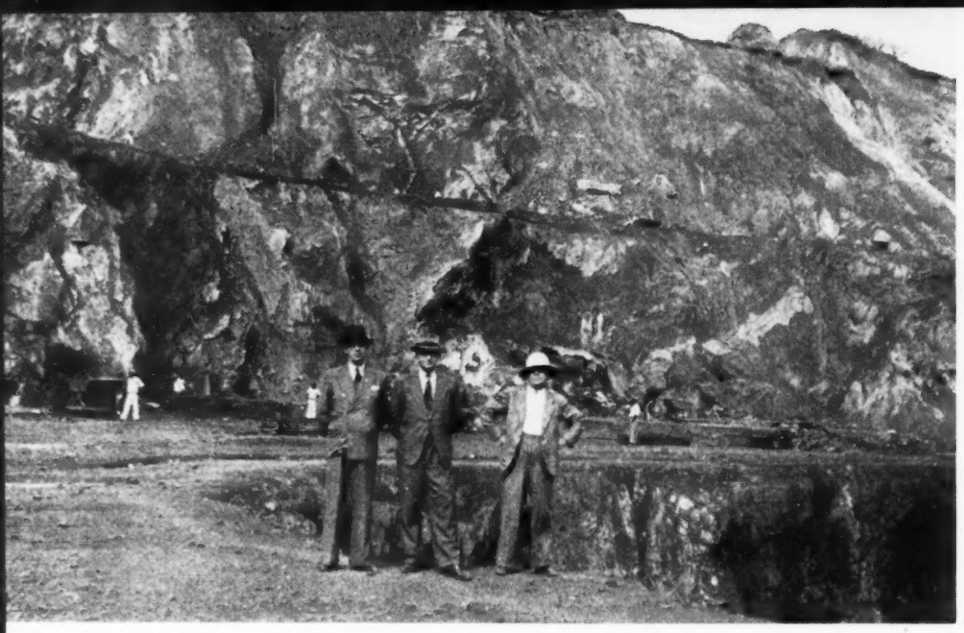
In the afternoon we inspected the Casa de Pedra iron mine, near Congongas do Campo, about 41 km. from Lafayette. Here high-grade hematite is mined from two benches of a long open pit. Mined material assaying up to 68 percent iron is transported by an aërial tram to the loading station on the Central R.R., 5,200 m. distant. Drilling is done with air machines and tramming by hand. The workings are laid out to give a maximum monthly output of 50,000 tons. The company also operates eight manganese mines in the district, of which the Agua Preta, adjoining the Morro da Mina, is the largest. Ary Belizario is director, and Pedro Canone, mine captain. All properties are owned by A. Thun & Cia.

Next day Dr. Teixeira and I motored to Nova Lima to see the Morro Velho and Espirito Santo mines of St. John del Rey Mining Co., which is English and the oldest registered in Brazil (1830). The property was acquired in 1834 and with few interruptions has worked ever since. It is situated in a hilly region not unlike the Grass Valley-Nevada City district in California at an elevation of 2,774 ft., with surrounding hills much higher, and the steep slopes covered with subtropical vegetation. The climate is mild and pleasant. The mine is one of the deepest in the world, with the lowest workings at a depth of 8,051 ft. Country rock consists of phyllite of the "Minas" series. The vein is continuous, dips into the mountain at an angle of 30 deg., and in shape resembles a long lima-bean pod. Average width of workable orebody is from 10 to 12 ft. with a maximum of 30 ft.

Besides the main orebody, three other deposits, the "X," Northwest, and South orebodies, have been found and partly developed by crosscuts and diamond drills at various levels. The orebody consists mainly of quartz, siderite, dolomite, calcite, forming the gangue materials and containing the sulphides—pyrrhotite, pyrite, and arsenopyrite. The latter carries most of the gold, which is rarely visible. Bands of quartz with practically no sulphides are occasionally found. Mined ore is brought to surface as soon as broken to prevent oxidation with a consequent increase in cyanide consumption. Much underground sampling is required, as there is no distinct line of demarcation between ore and waste. The mine is opened by a long entrance tunnel and five vertical shafts—namely, D, E, F, G, and H, connected by crosscuts. The lowest levels are served by two inclines I, and J. There are 29 levels, the upper being spaced at 300-ft. intervals and the lower at 200-ft. Development is chiefly centered in the "X" orebody, which has been explored between the 12 and 22 levels over a length of 6,230 ft. on the pitch. Below the 18 level it is wider and richer than the main orebody at these levels. Ore is mined by cut-and-fill, care being taken that waste filling is kept close to the stope face. It is believed that



60-ton manganese washing plant and concentrator at the Morro da Mina property



At the Morro da Mina manganese mine. Left to right: Dr. Magalhaes Gomes, Dr. Sylvio Barbosa, and Serafin Lana, manager

this is the principal reason that the underground workings have been free from rock bursts. Underground tramming is done by mules and electric locomotives.

The Espirito Santo mine is about 4 km. northeast of Nova Lima. It is developed by an incline to more than 1,220 ft. depth, and four orebodies are being worked. Production is about 500 tons, which is transported to the mill at Nova Lima by an aërial tram. The Morro Velho mine produces more than 800 tons a day. Of particular interest here is the air-conditioning plant. The company was one of the first to install such equipment. The first section, consisting of six ammonia compressors with their auxiliary machinery and having a total heat-extraction capacity of 100,000 B.t.u. a minute and requiring a power input of 900 hp., was installed in 1920. In 1930 a Carrier plant with two ethyl-dichloride turbo-compressors was installed on level 20, but was transferred to the surface in 1939 due to altered mining conditions. Its heat extraction capacity is 27,000 B.t.u. a minute, and power required 350 hp. Since installation of the plants, the wet-bulb temperatures in the stopes have remained around 81 deg. F.

The 1,500-ton mill is divided into two sections, one handling Morro Velho ore and the other that from the Espirito Santo. The ore in the latter section is treated in modern crushing and grinding units. The Morro Velho section at the moment is changing from old to new, and only a brief sketch of the milling practice is given, as some plans are still under study and the flowsheet may be incorrect a month or two hence. While working the main orebody only, the company never felt justified in modernizing extensively, considering its reserves definitely limited. Discovery of the "X" orebody changed the picture, but the work is somewhat slowed up by war conditions.

Briefly, treatment in the Morro Velho section includes two-stage crushing to 30-mesh, table concentration, regrinding in tube mills to give a 90-percent minus-200-mesh product, thickening, and cyanidation. Precipitation of pregnant solutions is done in a Merrill-Crowe plant. Batch cyaniding is practiced. Lead nitrate is added to the agitators, or "stirrers," and the agitation period is about 6 hr. A continuous cyanide plant is now being installed. About half the gold is recovered on the concentrating tables.

The crushed Espirito Santo ore is ground in a large Hardinge ball mill operating in closed circuit with a Dorr classifier. Separation of sand and fines in the regrinding department is made by two bowl classifiers. Thickening is done in a 60-ft. and a 120-ft. Geco thickener. Tables are of Holman make, and most of the other machinery is British. There is also a large roasting plant near the mill, where some ore is roasted prior to cyanidation and the arsenic recovered. Oliver filters have replaced the old Moore plant. In the melting room gold recovered is refined before being sent to the Bank of Brazil. The silver is removed by passing chlorine through the molten bullion, where it combines with the silver, forming silver chloride, which floats on top, while pure gold remains at the bottom. Resultant gold bars weigh about 25 kg.

After lunch we were shown the mine model at the office of Messrs. Davies and Grey, manager and chief engineer, respectively, two charming gentlemen who made our visit to Nova Lima an enjoyable one. Other company officers are W. R. Russell, business manager; A. H. Downe, mine superintendent; Harold Jones, mill superintendent; W. R. Trethewey, mechanical engineer; and G. K. Fletcher, electrical engineer. Power used at the mine, mill and camp is furnished by several large hydroelectric plants. I returned to Rio that afternoon.

Wages in Brazil are low, ranging from 45 to 75c. for labor, and $30 to $40 per month for white-collar workers. Imported goods and luxuries are beyond these people's reach. When I looked at some of the new skyscrapers recently completed in Rio, I found quite a bit of originality as to design and construction. The concrete work in particular, though unorthodox when measured by our standards, is unique. Naturally, local designers and builders do not have to take into account the extreme temperature changes prevalent in most sections of the United States.

All say that the steel plant now under construction will make Brazil independent of steel imports. Its rated capacity when completed will be around 300,000 tons a year, an output which will be sufficient for the railroads. Only simple forms will be rolled. The special products and alloys must come from another source. The same applies to the coal mines, which will furnish the fuel needed. Open-pit operations are projected for some, and when mechanization and washing plants have been completed, there will remain for the time the matter of efficient and low-cost transportation. New ports will have to be built and available ones enlarged, and provision will have to be made for adequate financing for these things.

Departing again from Rio de Janeiro on Jan. 5, this time for Buenos Aires, we left Santos Dumont airport in a two-motor Douglas plane exactly at 8 in the morning, arriving in Buenos Aires just before 4 p.m. The trip was uneventful and flying weather excellent. We passed over somewhat hilly country until Porto Alegre, then came the endless pampas of Uruguay, and finally the Rio de la Plata and B.A. The states of Santa Catarina and Rio Grande do Sul, especially the regions around Joinville, Blumenau, Porto Alegre, and others, looked more like Germany than Brazil. Cities, villages, farms—yes, even the houses—were replicas of those found in Southern Germany. The population of these states is predominantly German, I was told by officials at Porto Alegre, our only stop during the entire trip.

At the B. A. airport everything was settled with dispatch and efficiency, with practically no police formalities except that of stamping the passport. The Argentine is perhaps the easiest country to get into and out of at present. After a bus ride lasting almost an hour we arrived in the center of Buenos Aires, and what a city it is! It is unquestionably the New York of South America, in its speed, efficiency, and all, though perhaps a little friendlier. Rio is more like New Orleans, the tropical climate slowing up things quite a bit. In B. A. I got the feel of things immediately. The people are frank and open, and follow more or less a standard pattern of behavior.

As to mining in the Argentine, inter-

est is centered in zinc, lead, tin, and tungsten. Efforts are being made to increase production as rapidly as possible, and considerable prospecting is being done. The outstanding producers are Cia. Minera Aguilar, Cia. Minera Pirquitas, and Sociedad Minera Argentina, also known as Sominar, headed by Mr. Williams (zinc-lead, tin-silver, and tungsten respectively). In view of the fuel shortage, some coal mines are being opened up in the southern part of the State of Mendoza to supply the Buenos Aires electric power and gas works. Incidentally, many will be interested to hear that quite a few boilers in the power plants are fired with corn. Cia. Minera Pirquitas is using corn instead of anthracite as a reducing agent for converting concentrates produced at the mill and washing plant to metallic tin. The smelter of the National Lead Co. is treating both custom concentrates and those of Cia. Minera Aguilar. I was also told that an English company is prospecting some lead-zinc deposits in Patagonia, and that Sominar is developing sulphur deposits.

Respecting the future of the Argentine mining industry, some are optimistic, others pessimistic. All will depend on the outcome of the present war, and how far the local government intends to carry its nationalistic policies. If continued on the present scale, mining will increase, but should there be any change of heart, it is quite possible that the market will be opened to metal imports at prices lower than the locally produced materials, with consequent reduced activities.

The story I got from talking to those upon whom I called is this: The Argentine, contrary to other Latin-American countries, has never been thoroughly searched for minerals either by the old Spaniards or by the people following them. Up to the World War mining was neglected for agriculture and other industries, and failures and fake promotions played a certain part in crippling mining. In other words, there is plenty of territory to be prospected, and time alone will tell what new mines will be found. Another factor that has retarded mining here was the absence of a Mining Bureau and Geological Survey. This defect, however, is being remedied rapidly.

In the evening I had a delightful visit and dinner with R. T. Cornell, of the Cia. Minera Aguilar, S. A., who had just returned from the mine in Jujuy. We talked about mining, Argentina, mining legislation in the Argentine, labor, etc., until way past midnight.

Next morning, Jan. 10, exactly at 9 a.m. we left via Panagra for Santiago, Chile, arriving at Los Cerrillos airport at 3:30 p.m. I shall never forget this trip, especially the flight across the Andes. The weather was clear two hours after leaving Buenos Aires, and the scenery below magnificent. First, the seemingly endless pampa with its fertile fields, desert country, in places quite hilly, and the great salt beds of the Pampas de Las Salinas region after Cordoba, then Mendoza with its grape and fruit orchards, and finally the flight at more than 16,000 ft. through the Uspallata Pass, during which I thought on several occasions that the wing tips of the plane would touch the steep canyon walls. We passed the Christ of the Andes at 3:10 p.m., and sighted Santiago scarcely 15 min. later. Mt. Aconcagua, the 23,098-ft. colossus, at times seemed close enough to touch during the flight. The region is completely barren, and after emerging from Uspallata Pass I thought for a moment that I was flying over some areas of our own Southwest.

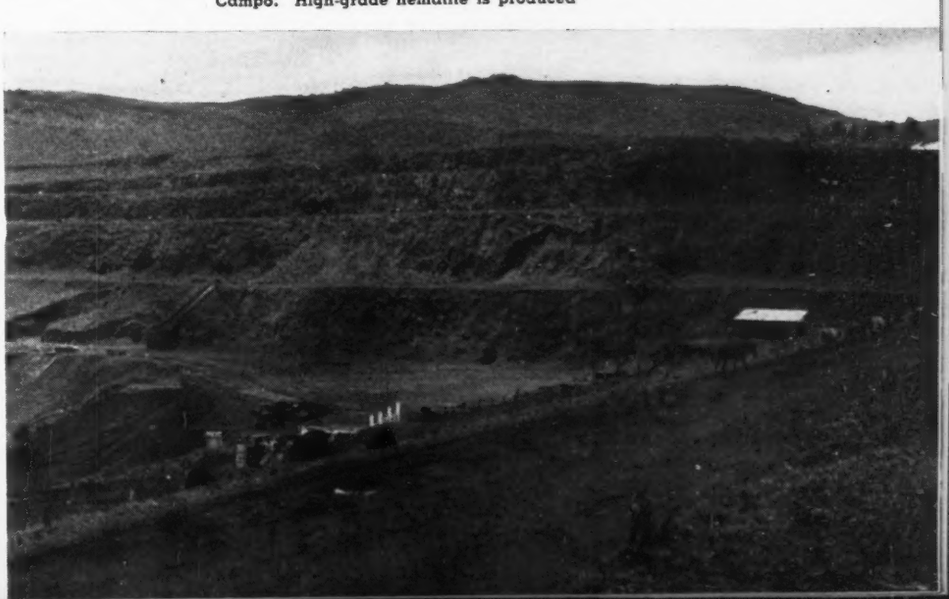
At the airport I was met by a reception committee of the Congress headed by Tomás Vila, and in less than 30 min. after completing landing formalities was installed at the Hotel Crillon. Monday morning I presented myself at the headquarters of the Congress, where I met Ing. Marin Rodriguez, president of the Institute de Ingenieros de Minas de Chile; Ing. Roberto Muller, executive vice president; Ings. Enrique Vial and Tomás Vila, and a host of delegates from Argentina, Equador, Brazil, and other parts of the Americas. After the visit I called on P. A. Seibert, business manager, Braden Copper Co., J. R. Cotter, Anaconda Copper Mining Co. (Andes Copper, Chile Exploration), where I met D. Dunbar, mine superintendent of Chile Exploration Co. at Chuquicamata; Sali Hochschild; Horace Graham of Anglo-Chilean Nitrate; and others.

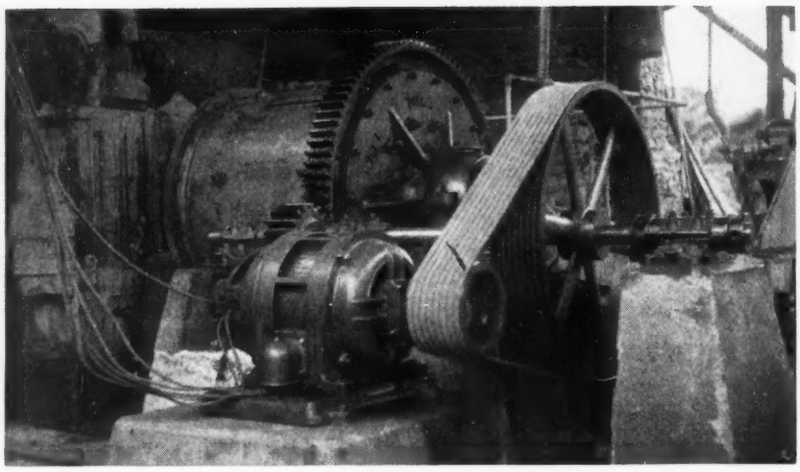
Wishing to take advantage of the three days before opening of the Congress, I arranged with Mr. Seibert to visit the operations of Braden Copper Co. at Sewell. According to the itinerary prepared by Mr. Seibert, Mr. Dunbar and I left Santiago on the State Railway at 7:30 in the evening, arriving in Rancagua at 9:30 p.m. We stayed here over night, as no transportation facilities to Sewell were available until 8:30 next morning. The trip to Sewell, 70 km. distant, was made over the narrow-gage company railroad in an auto-rail car. The line is one of the neatest engineering jobs in South America. In Sewell we were met by W. J. Turner, general manager, and F. E. Turton, assistant general manager, whose courtesies I shall never forget. Everything was done to make our visit pleasant and interesting. Both are very able men, and their spirit is in evidence everywhere in Sewell. To run the Braden operations efficiently is no easy matter.

Sewell now has 12,000 inhabitants, and to house, feed, and police them, and watch their health and other requirements, is a job almost as big as running the mine, mill, smelter, and power plants. As space is at a premium, the people are housed in modern apartment buildings grouped around the reduction works. The company also maintains an excellent hospital, schools, and club houses at the different units. Use of liquor is prohibited on company properties. Power for the plants, town and settlements is obtained from hydro-electric plants on the Cachapoal and Pangal rivers, each with a capacity of 22,000 kw., which is transmitted at 66,000 v. The line

View of locally developed 60-ton shaking concentrator at Morro da Mina plant

Benches in Casa de Pedra iron mine, operated by A. Thun & Cia., near Congongas do Campo. High-grade hematite is produced





Denver ball mill in 500-ton pyrite washing and concentrating plant of Impresa Mineira de Pyrita, Ltd., near Ouro Preto

to the *patio* and shops at Rancagua carries 33,000 v.

As known, the Braden holdings are in the western Cordillera 80 km. southeast of Santiago, and comprise a total of 240 sq.km. of territory. The *patio* at Rancagua covers about 39 hectares. The mine is at an elevation of 7,458 to 9,960 ft., and 3½ km. from the concentrator. Current daily production is 25,000 tons, mined from the El Teniente section of the property. The orebodies under exploitation lie around the periphery of an explosive vent in the form of crescent-shaped deposits, limited on the inside by the tuff contact, where they are of higher tenor. The upper limit is formed by the bottom of the oxidized zone extending from 50 to 100 m. below the surface, and the lower limit by the contact with the primary zone. The explosive eruption responsible for the Braden vent fractured the andesite porphyry intensely surrounding it, the width of the zone of most intense shattering ranging from 100 to 600 m., and the widest portions being on the northeast side of the crater. Chalcopyrite and chalcocite are the chief copper minerals, with small amounts of bornite and covellite. Topography around Sewell is rugged and barren. Mountain sides are steep, averaging 30 deg. or more, with snow slides occurring during the winter.

The mine proper is developed by a series of adits, shafts, and inclines, the latter two being used for handling men and materials. Most of the work underground is done on contract, chiefly on a meterage basis. Ore is mined by block undercutting—a development of the experience with stoping and pillar caving obtained at Braden. Operations underground are mechanized wherever possible.

There are three general types of drifts and crosscuts: those used for hand tramming measure 7½x9½ ft.; those for motor haulage, 10x10 ft.; and those for access to control gates and the caving sections for handling supplies, 7½x9½ ft. Drilling is done with mounted jackhammers using ⅞-in. hexagonal steel, and in the raises with stopers with drills made from 1⅛-in. cruciform steel. Ammon-Gelignite (25 percent) fuse and detonators are used in blasting. Depth of round broken is around 1.47 m. Loading of ore broken in development drifts is done by hand into 1-ton cars. Some mechanical loaders with 5-ton cars are used in the larger haulage drifts and crosscuts. Ore drawn from chutes at the bottom level of the mine is hauled to the mill in trains of 12 cars by 25-ton electric locomotives. The cars are of the gable-bottom type and hold 24 tons each. The 3½-km. line from mine to mill is laid with 60-lb. rails, spaced 30 in., with a 0.5 percent grade in favor of the load. Capacity of the concrete, square-bottom coarse-ore bins at the head of the crushing plant is 12,000 tons.

Crushing to mill feed size is done in two stages. The ore is fed to the five individual mill sections by six Amsco pan feeders and five 48-in. cross belts feeding onto a steel grizzly, spaced 1 in. Oversize is reduced in a 7-ft. Symons cone, and the undersize and the crusher product are passed over a 10x4-ft. Utah vibrating screen. Screen undersize is conveyed direct to the fine ore bins of 20,000 tons' capacity, and the oversize goes to the secondary crushing unit, where Garfield-type rolls (three 72-in. and four 54-in.) and four 7-ft. Symons short-head cone crushers operating in closed circuit with two or four 5x4-ft. Utah vibrating screens (rolls have two, and Symons four) with 0.328-in. openings reduce it to mill-feed size, which is minus 3 mesh. Dust is controlled by a Lynch dust-collecting plant.

On the primary grinding floor there are twenty 8x12-ft. Marcy ball mills running at 23 r.p.m., and fitted with ball retarder grates ± 24-in. diameter and 1-in. slots. Ball charge is 30 tons (3½-in. cast-steel balls). Two mills with 12-ft. FX Dorr classifiers constitute a section, and daily output is 2,500 to 2,700 tons. The elevators serving each circuit carry a sand load of ± 10,000 tons. Sizing on the primary grinding circuit is about 25 percent on 48 mesh, and 50 percent — 100 mesh.

In the secondary-grinding circuit each section consists of four 8-ft. by 48-in. Hardinge ball mills with two 25x16-ft. Dorr bowl classifiers. Sand load average 5,000 tons. The circuit is closed with 42-in. bucket elevators. In this section the material is ground to 10 percent plus 100 mesh and 70 percent minus 200 mesh.

In the flotation plant 36 10-cell standard M.S. machines produce a bulk copper concentrate. Eight cells of each machine make a concentrate and two middlings. Tailings go to a 100-ft. Forrester-type scavenger, from which low-grade concentrates are returned to the head of each primary flotation unit and tailings are pumped to waste dumps. Reagents added to the primary mills are Minerec "A" and cresylic acid, consumption per ton being 0.07 lb. and 0.27 lb. respectively. About 3.7 lb. of sulphuric acid (68 percent acid) are added to the flotation feed. Concentrate produced contains 26 percent copper and 24 percent iron. It is treated in a separate plant to drop the pyrite and raise the copper content to 34 percent and lower the iron to 20 percent. Here the bulk flotation concentrate is separated into coarse and fine portions by 8x20-ft. Dorr-Mitchell type classifiers, with a slope of 1½ in. per foot and a rake speed of 4 s.p.m. Overflow goes to an 18-in. hydro-separator to remove additional coarse material. Underflow from this unit and classifier sands are reground in a lime circuit, and subsequently treated by flotation to remove pyrite. About 400 tons of pyrite is separated and returned to the mill tailings after first removing from 70 to 80 tons of coarse material for the acid plant by means of a Dorr-Mitchell classifier.

Copper concentrates produced in the plant are dewatered in three 60x12-ft. Dorr thickeners before going to filtration plant. Overflow from the hydro-separator is pumped to 30 cells of a standard M.S. flotation plant in series, followed by 200 ft. of air cells in series to discard about 80 tons per day of 1 percent slime concentrates. This aids filter operations materially and appears to benefit the smelter by eliminating Al_2O_3. In case the SO_2 content in the concentrates is too low for the smelter, a sand pocket on the main tailings race is fitted with a 1-in. Dorreo pump, which can return from 10 to 40 tons per day of granular material to the concentrates. This aids the filtering of finished concentrates.

At the filter plant four 14x14-ft. Dorreo filters are available. Cake at 11 percent moisture is delivered by a 36-in. conveyor belt to a 4,000-ton shipping bin served by a 10-ton Shaw

crane with a 4-ton Brownhoist bucket, which transfers it to the aërial tramway hoppers. The tramway is a 100-ton bi-cable American Steel & Wire unit, 4 miles long, with buckets of 2,500-lb. capacity.

Of interest is the tailings disposal system. It consists of a dam 37½ miles west of the mill at 2,150 ft. elevation, and a flume system starting at 7,000 ft. The flume line follows past Barahona site to Goya, 10.6 miles distant, with grades of 1 to 3 percent. This section has 3,300 ft. of masonry chutes on 41 percent grades to avoid extra grades on the flume. Below Goya 16 miles of flume is on a 0.3 percent grade, and all upper sections are on a 1 percent grade, and lined with 2-in. concrete slabs. A total of 6,233 ft. of steel bridges are contained in the lower sections, the largest being 1,132 long and 248 ft. high. The 3,000-acre Cauquenes dam basin is enclosed by a narrow opening across which a sand dam was built by pumping sand at 60 percent solids from a stationary desanding plant. It contains about 2,700,000 tons of sand, and is covered on all sides with 12 in. of earth planted with grass. The basin can store 300,000,000 tons. Overflow passing through a concrete-lined tunnel at one side is reclarified in 120 acres of settling ponds.

Mill heads average about 2.15 percent copper. The ore treated is medium hard, with mineral particles finely disseminated. Losses of middling occur well below 400 mesh. Recovery varies from 84 to 90 percent, depending on the cleanness of the ore and fineness of grinding. Small amounts of molybdenite are recovered from the pyrite discard by reactivating the MoS_2 with burner oil. Rougher concentrate from three Fagergren cells is cleaned in four No. 12 Denver cells the product of which is roasted at 380 deg. C. in a 12-ft. three-hearth roaster. The calcines are refloated in No. 12 Denver cells to make a finished product.

The smelter is at Caletones, which receives concentrates via the 4-mile aërial tram mentioned previously. Equipment available includes eight roasters, two oil-fired reverberatories, four Peirce-Smith converters, and two refining furnaces serving Walker casting wheels, Cottrell plants, and other auxiliary units. Both blister copper and ingots are made, with a purity of 99.50 and 99.90 percent respectively. The company also operates a modern brick plant near the smelter. Repair shops are maintained at Sewell, Caletones, and at Rancagua, and everything from common nails to filters is manufactured. Besides Messrs. Turner and Turton, I met L. T. Higgins, mill superintendent; B. L. Johnson, assistant mill superintendent; R. W. Jigins, metallurgist; J. S. Webb, mine superintendent; J. P. Withers, assistant mine superintendent; A. E. Schwartz, mechanical engineer; H. M. Fleming, smelter superintendent; and H. A. Shaw, assistant smelter superintendent.

(To be concluded)

Salivation Hazard Lessened in Quicksilver Mining

The remedy is found in spraying with lime sulphur solution all places and objects that can harbor the native mercury

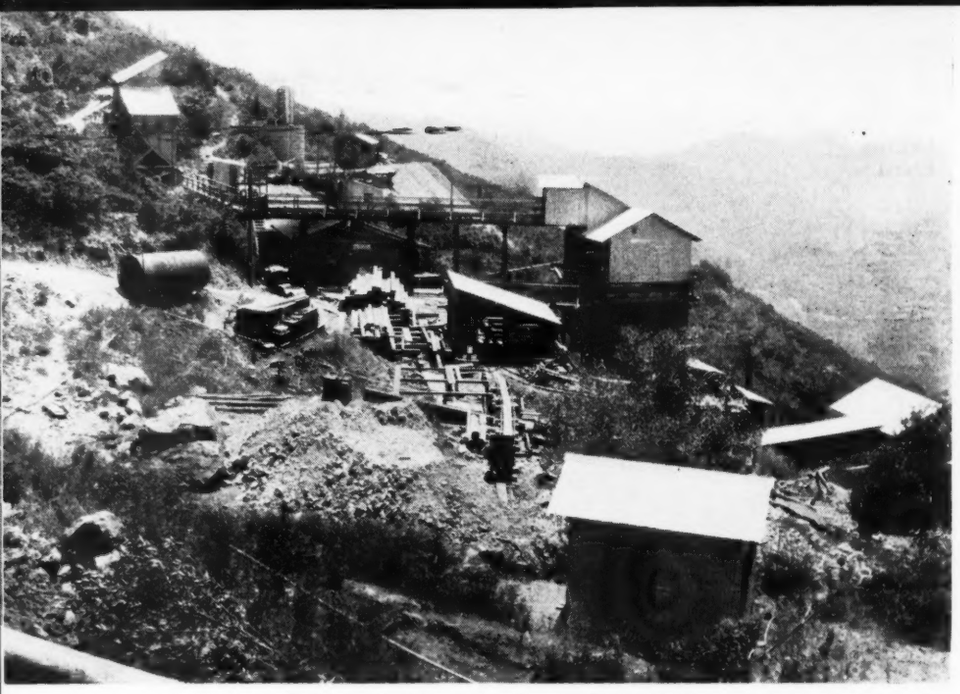
Thomas Soule
Chief Engineer
Industrial Indemnity Exchange
310 Sansome St., San Francisco

Prof. Merle Randall, of the Chemistry Department, University of California, who is credited with devising the successful means of coping with the salivation hazard, here described. Photo by J. F. Hink & Son Studio

SINCE MAN FIRST MINED quicksilver, the spectre of salivation (mercury poisoning affecting the salivary glands) has stalked through every operation where native quicksilver appeared in any great quantity. How many mines have been closed down and abandoned over the years because of this hazard, no one can say. We do know that the Contact quicksilver mine, 17 miles north of Healdsburg, in northern California, nearly joined that unnumbered group of abandoned mines. What saved it? What made it a safe and profitable operation? An inexpensive chemical spray developed by a professor at the University of California.

The Contact mine first came to our notice in 1937, when its owners applied for workmen's compensation insurance in the Industrial Indemnity Exchange. Little development work was done at that time, but in 1939 a shaft was sunk to approximately 300 ft. and a headframe and hoist were installed. On May 6, 1940, the operation was thus described by Frank Newton, Industrial Indemnity safety engineer and expert on mining operations:

"This is a clean, well-constructed camp. Special care has been given sanitary conditions and ample facilities provided for the men to wash and clean up. Natural ventilation in the mine is excellent; however, in addition to this, an 11-in. blower has been installed, capable of distributing air to all parts of the mine. In the development headings, an exhaust fan has been installed. There is also a compressed air pipe to all parts of the mine.



Contact quicksilver mine, near Healdsburg, Calif. The mill and smelter are down the hill at extreme right. Photo by Langhart Studio, Healdsburg

"This is a very rich quicksilver mine and the veins are in both cinnabar and native quicksilver. Throughout the vein the native quicksilver stands out on the ore in globules and in raking the ore a small pool of native quicksilver can be formed.

"Blasting is done but once a shift and at least three hours is allowed between blasting and the time the men return to work. There are showers and a change room and water is provided through the mine where the men can wash their hands and faces. All men have been warned that they must not smoke or touch anything that goes into their mouths until they have thoroughly washed."

Despite these precautions, a large proportion of those working underground developed mercurial poisoning (salivation). Due to the short duration of the exposure none of these cases developed seriously, but were prevalent enough to cause concern. In August the mine was shut down pending reorganization. In October, 1940, it was acquired by the Contact Quicksilver Co.

The new owners knew the mine's history. Working with their insurance brokers, Johnson & Wright, Inc., of Oakland, and with Industrial Indemnity Engineers, they immediately took steps to make sure that every known precaution was taken to remove the salivation hazard. New jumper suits were ordered for all men. These were laundered each day and a new change house built. Rules folders were ordered for the men and rigid instructions as to sanitation were enforced. Mr. Newton's report on Feb. 4, 1941, was to the effect that "They are certainly trying to carry out all previous recommendations."

But by March 1, 1941, Mr. Newton found the management "much concerned over the few recent cases of salivation." He further reported:

"We find that men have become salivated while drilling. This happens especially when they are drilling an upper hole in a stope. Many times when the drill hits a deposit of free quicksilver the man is covered by cuttings from the drill which go through his clothes. To eliminate this hazard as much as possible, the men wear rubber gloves and coats. We are trying to improve on this by outfitting each man with a cape that fits tight up around the neck. We are also hanging a small suction hose right at the hole being drilled. This will take away all the discharge from the hole by means of a small portable fan. Mr. Wright (of Johnson & Wright) is taking up a sand-blaster's helmet tomorrow to be tried out, but I doubt that it will prove practical underground. They have a blower on top and a booster blower for the air going down to the winze."

On April 22, 1941, the California Industrial Accident Commission, the U. S. Bureau of Mines, and the Industrial Hygiene Service, State Department of Public Health, made a test of the air in the mine to determine the amount of mercury vapor and dust. They found it contained approximately ten times as much mercury as there should be. At the time the ventilation system was on exhaust. After this test the management changed the ventilation to blowing, and men underground reported that conditions "seemed improved." However, on May 8, a test showed that the amount of mercury vapor present was the same as in the April test.

Mr. Newton's May 8th report says:

"I have come to the conclusion that to solve this problem some means, in addition to ventilation, must be employed. I talked this over with Mr. Wright and suggested that all places where there is free quicksilver be gunited with a thin coating of gunite sufficient to seal the surface and prevent the evaporation of the mercury into the air. . . . Mr. Wright informs me that Professor Randall, of the University of California, has a chemical that he can spray upon the interior of the mine and prevent any mercury evaporation. In the meantime, all mining on the 250 level was stopped and will not be resumed until some method of controlling the amount of free mercury in the air has been worked out."

A method was worked out at a meeting held in Johnson & Wright's insurance brokerage office in Oakland on May 13. Attending that meeting were: Edward E. Dart, M.D., medical officer; Fred R. Ingram, supervising engineer, and S. F. Dommes, Jr., assistant engineer, of the Industrial Hygiene Service of the California Department of Public Health; H. B. Humphrey, district engineer, U. S. Bureau of Mines; Fred Lowell, supervising mining engineer, Industrial Accident Commission; Prof. Merle Randall, of the chemistry department of the University of California; Allen Wright, partner in Johnson & Wright, Inc., and myself.

Professor Randall, widely known as a specialist in toxic gases, has devoted years to the study of mercury, both in its physical and chemical properties. At the meeting he pointed out that the evaporation of mercury parallels that of water. In other words, after a certain velocity in the volume of air has been reached, any increased velocity of air will increase the evaporation of mercury.

From this it was evident that the problem of freeing the Contact mine of mercury vapor was not a problem of increased ventilation. For increasing the volume of air flowing through the mine would simply increase the amount of quicksilver in the air through increased evaporation.

Professor Randall's suggestion was that the walls, floors, timber, pipes, wires, ladders, and every other article in the mine which could possibly harbor native quicksilver be sprayed with lime sulphur solution. This suggestion was based on the known fact that in mines where the values occur in mercuric sulphide, there is no salivation whatever, as mercuric sulphide itself is one of the most insoluble of the sulphides. In other words, if the metallic mercury could be coated with some substances which would prevent evaporation, or could be converted into a sulphide dust, the amount of native or free quicksilver in the air could be materially reduced.

The recommendations of Professor Randall were carried out within the next few days. Using a common hand-type of orchard-spraying device, everything in the mine was sprayed with this inexpensive chemical solution.

Through the cooperation of the U. S. Bureau of Mines, a selenium-sulphide detector of mercury vapor was loaned to make tests after spraying. This apparatus consists of a 25-watt bulb inside an aluminum chimney. At the top of the chimney a small piece of selenium sulphide paper is placed. Any mercury vapor passing the test paper reacts with the selenium sul-

phide, to form mercuric sulphide, which causes a blackening of the paper. The amount of mercury in the air is determined by comparison of the depth of darkening of the paper in a given time with a standard color chart.

Immediately after the mine was sprayed, this lamp was set up for from one hour to four hours a day. At no time was the paper discolored. Previous to the spraying, the paper had become so dark after an hour's exposure that it had to be be removed.

On May 27, Mr. Ingram, already mentioned, conducted two 4-hr. tests. One was in the main working level between the stopes and directly over the ore pockets. It went on while ore was being drawn from the stope and dumped into the bins. It showed but 0.15 mg. per cubic meter of air. Before spraying, a test in the same location showed approximately 1.64 mg. per cubic meter.

The second test was made in the stope itself while drilling was going on and is considered the more severe of the two. After four hours of testing, a concentration of only 0.16 mg. per cubic meter was revealed. Before spraying, the sample taken under like conditions showed, approximately, 1.77 mg. per cubic meter.

In the meantime, the Contact mine purchased a test lamp and continued to test the air at frequent intervals. At no time have they found concentrations above the allowable limits.

On July 8 and 9, 1941, Messrs. Lowell and Ingram again visited the mine and with two test lamps took six samples. At no time did the concentration of free mercury exceed the allowable limits.

Inasmuch as the safe limit is between 0.10 and 0.20 mg. per cubic meter of air, readings of 0.15 and 0.16 are considered within the allowable limits and there is every indication that the Contact mine is now free from dangerous concentrations of mercury vapors.

As I understand it, the principle involved is something like this: Calcium polysulphide is a compound containing a high excess of free sulphur. As this is sprayed in the air or on an object, the free sulphur will unite with any metal with which it comes in contact, as it has a strong affinity for metals, especially mercury. In effect, when a mine containing native quicksilver is sprayed with this solution, a coating of mercuric sulphide is formed on the native quicksilver. This is insoluble both in air and water.

This comparatively simple solution is an outstanding example of the value of scientific effort, as exemplified by the work of Professor Randall, to an industry and its employees. Much credit should also go to Fred Lowell, of the Industrial Accident Commission, and to the Public Health and U. S. Bureau of Mines officials who gave valuable cooperation throughout the long period during which a solution to this problem was sought. These men will agree that the results were worth the effort.

Use of the procedure, of course, is designed primarily for the protection of men. But, as in all other safety measures another important advantage lies in the reduction of compensation insurance costs which will result from its use. For since premium rates reflect loss costs, any reduction in such costs eventually affects rates favorably. In this particular case, it has been estimated that the cost of using the process will eventually be more than offset by elimination of the hazards of mercuric poisoning.

The procedure described is the sole property of Merle Randall, 2512 Etna St., Berkeley, Calif., to whom inquiries regarding license for its use should be addressed.

Fire Prevention Planning for Mines

NUMEROUS EXAMPLES of fire hazards have been studied by me at various times, and recommendations were made to correct conditions where possible, or to install fire-prevention and fire-fighting apparatus where the situations could not be corrected, writes J. S. Baker, Washington, D. C. These are discussed to suggest that men working on a property sometimes develop "blind spots" on fire hazards.

Case I—A prominent gold-mining company in the Philippines was handling approximately 2,000 tons of ore per day, all of which was dropped through transfer raises to a main haulageway where electric locomotives transported it to the crushing plant. The ventilation was so designed that an adit 500 ft. above the main haulageway was one of the intakes. The steep slope of the mountains had caused the engineers to construct buildings one next to the other to such an extent that the available ground was covered with two- and three-story wood structures around this portal. Directly adjacent to the portal was a storeroom in which carbide and rubber were kept on a dirt floor some two inches lower than the outside grade level. Heavy rains occurred periodically and it became necessary to build up small dirt dikes around the entrance to the storeroom to prevent water from pouring in. Some of the drums were broken and carbide had spilled. Ideal conditions existed here for a major conflagration. One hundred feet from this storeroom was a temporary dynamite magazine containing 300 cases of 30 and 40 per cent gelatin. Opposite this was a change room where some of the bosses would hang their lights and on several occasions small fires had occurred. The conditions were pointed out to the mine superintendent and were remedied.

Case II—A large gold-mining company in mountainous country, 14 miles from the nearest fire-protection system except for such extinguishers and limited water supply as was available on the property, had constructed its buildings in a narrow valley through which a steady wind blew toward a saddle above the buildings and above a downcast shaft. The shaft was at the head end of the canyon, the mill next, the offices and storerooms next, and on down to the workers' quarters. In the storerooms were approximately $350,000 worth of supplies. A ball of waste was piled in a corner underneath a rack containing rubber belting, hose, and tires. On this bundle of waste had been placed a partially filled drum of cottonseed oil which had been tilted, spilling onto the waste in some quantity. This was an ideal condition for spontaneous combustion. The fire control and prevention system was overhauled.

Case III—A property 60 miles from the nearest town in mountainous territory where the main hoisting shaft was upcast but where complete cessation of operations would have been necessary had the shaft been destroyed. The headframe, approximately 70 ft. high, had been covered with siding and the rope line from the sheaves to the hoist had been inclosed in a structure attached to the headframe, making the hoist house and headframe into one big building in which repair shops and mine offices had been placed. The drill repair shop was midway in this structure below the main transmission cables suspended on one side of this structure. In this shop kerosene, oily rags, and some gasoline were kept. The repair man worked one shift only. If any fire occurred it would have resulted not only in the loss of the headframe, numerous supplies, and office records, but also in the severing of the main power cables supplying camp and mine. The report covering this situation was submitted to the general superintendent and resulted in immediate remedying of the situation.

Cartersville Manganese Ores Studied in T.V.A. Laboratory

Magnetic roasting tests give promising results

RESEARCH AND TESTS conducted in connection with magnetic roasting of manganese ores in the Cartersville district, Georgia, is summarized in a bulletin[1] recently issued by the State Department of Natural Resources, Division of Mines, Mining and Geology, Captain Garland Peyton, director. This work was done at the request of the Division and in cooperation with it at the minerals testing laboratory of the Tennessee Valley Authority at Norris, Tenn., between May and November, 1941. It represents a brief practical study of the problem of improving the quality of manganese in low-grade manganese concentrates of the district named. Some data are included in the report from which competent operators may fairly estimate operating costs. An abstract of the results follows:

The tests made were carried out on washed concentrate ore of the following approximate analysis: manganese, 21.4 percent; iron, 27.0; insoluble, 11.2. Results of magnetic roasting and subsequent magnetic separation indicated that 61 percent of the roasted ore can be separated into manganese and iron concentrates.

The combined roasted product constituted 85.7 percent by weight of the original washed concentrate ore and analyzed as follows: manganese, 25.42 percent; iron, 31.41; insoluble, 12.0.

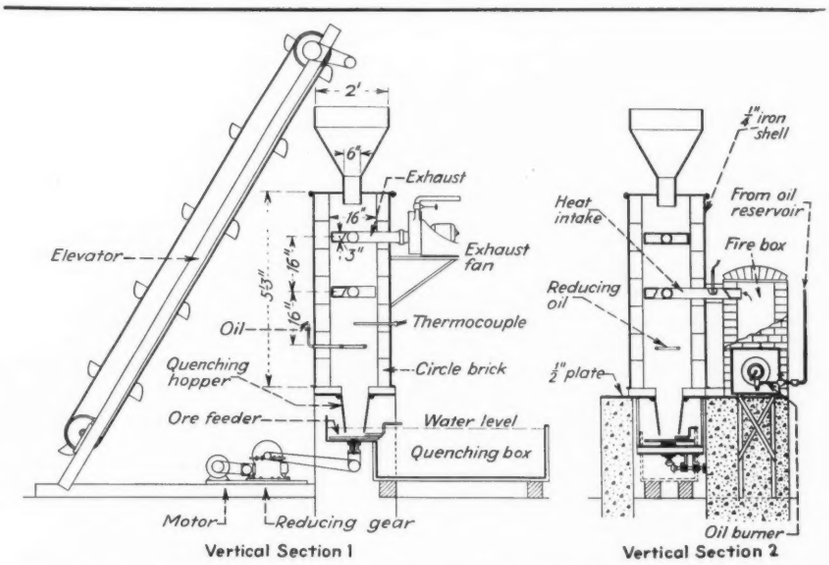
By closely controlling the jigging of the manganese concentrate, the following three fractions were obtained:

1. Manganese concentrate after jigging, 32.0 percent by weight (loss in jigging 3.7 percent by weight). This concentrate analyzed as follows: manganese, 45.10 percent; iron, 6.41 percent; insoluble material, 12.0 percent.

2. Iron concentrate, 25.3 percent by weight. This concentrate analyzed as follows: manganese, 8.74 percent; iron, 55.1 percent; insoluble material 8.1 percent.

3. Middlings, 39.0 percent by weight. The analysis was: manganese, 23.3 percent; iron, 34.16 percent; insoluble material, 12.2 percent.

All of the products separated are believed by the Division to be marketable at present. The results given are for one set of conditions. To evaluate the work covered in terms of commercial application, the report must be studied in its entirety.



Sketches illustrating the type of furnace used for the magnetic roasting of the Cartersville ores

As for commercial application, the results represent conditions of roasting, magnetic separation, and jigging of the manganese concentrate considered optimum, but not beyond the limits of ordinary mill operations. Close control of the several operations is imperative. Moreover, certain features require particular attention. Among them are:

1. The roasting furnace must have an airtight reducing chamber.

2. Reasonably accurate control of the temperature and reducing agent are required.

3. The rate of processing must be carefully regulated by the ore discharge to allow sufficient time for heating and reducing the ore.

4. Means must be provided for cooling the roasted ore without contact with the atmosphere. This may be done by quenching in water.

5. Magnetic separators with controlled magnetic intensities must be provided, by the use of which the production of the middling product may be regulated.

6. The jigging of the feed to the furnace or the manganese concentrate must be closely controlled. By this operation, silica and iron, contained in the insoluble particles, are removed from the manganese concentrate.

The costs of magnetic roasting with a furnace of two tons per hour capacity, it is estimated, should not exceed $1.50 per ton. It is not unreasonable, under present market conditions, to expect a profit of $2 per ton of ore processed by the method outlined, assuming a steady processing of 90 percent capacity in a furnace designed for the production of two tons per hour. The preliminary report includes details and data by the examination of which the foregoing has been estimated.

Large-scale tests on the manganese-iron ores were confined to the roasting step, and only small-scale laboratory magnetic-separation testing was applied.

To check the results of the magnetic separation on equipment of commercial size, roasted ore samples were sent to various manufacturers of magnetic separation equipment for testing. These results, though not complete, indicate that the laboratory magnetic separations given can be equaled or improved on commercial separators.

[1] "Magnetic Roasting Tests of Cartersville Manganese Ores (Preliminary Report)" Information Circular 13, Department of Natural Resources, Atlanta, Ga.

Mahoning's New Diesel Unit Generates 240 Volts A.C.

This voltage is used exclusively at new fluorspar-lead-zinc mine

J. H. Edwards
Electrical Editor

NOT OFTEN is alternating-current power generated at 240 volts, but that is the case at the new W. L. Davis mine of the Mahoning Mining Co. near Cave-In-Rock, Ill. A new diesel generating unit has been installed to replace a reconditioned diesel which served during the first few months of operation. This mine produces 200 tons of fluorspar-zinc-lead ore per day and the output is trucked to a new mill which the company has in operation at Rosiclare, Ill. Mine pumping is done with a motor-driven deepwell turbine pump installed in the shaft. Ventilation is accomplished by motor-driven blowers at the tops of 6-in. boreholes.

The mine shaft is 300 ft. deep and for the most part the production is coming from blanket deposits 10 to 15 ft. thick on the 300-ft. level. Ore is hand-loaded into hoisting tubs carrying 1,400 lb. each, which are hauled to the shaft bottom on 24-in. gage cars pulled by a storage-battery locomotive. The ore hoist, a single cylindrical clutch-drum type made by the United Iron Works, is situated at the top of the headframe and is V-belt driven by a Ford-Mercury 95-hp. gasoline engine with General Power Co.'s mounting arrangement with outboard ball bearing and pulley. The hoisting rope is $\frac{5}{8}$-in. plow-steel grade double-twist non-spinning and the speed is 1,200 f.p.m.

At the extreme right of the picture in Fig. 2 is the new diesel engine, a Fairbanks-Morse two-cylinder rated 120 hp. at 360 r.p.m. The alternator (extreme left) is a 125-kva. Allis-Chalmers unit delivering 240 volts at 720 r.p.m. The same engine, through another pulley fitted with Conway clutch, drives an Ingersoll-Rand 600-c.f.m. air compressor, now operated at low speed because full capacity is not needed. The old diesel, the top of which can be seen in the center background, is a 6-cylinder Atlas-Imperial 120-hp. high-speed unit. Dependability, lower maintenance, greater overload capacity and lower fuel cost were the reasons for buying the new engine.

For some months after the mine was opened no high-line power was to be had in the community where the mine is situated. Recently a Rural Electrification project made a limited amount of power available to the mine. This is not used during the working shift but is connected at the end of the shift when the power plant is shut down. This R.E.A. power is then used for pumping, ventilation and charging the locomotive battery.

Although the battery requires only 42 volts d.c., the charging set is on the surface, in a corner of the power house. Lines delivering this 42-volt power through a borehole to the charging station underground are No. 1 B.&S. The charging set is a motor-generator made by the Hertner Electric Co., of Cleveland. The locomotive, Fig. 1, is a 2-ton Goodman carrying a 24-cell Exide-Ironclad battery.

Capacity of the turbine pump, shown in the shaft-top view, Fig. 4, is 300-g.p.m. capacity and the total lift is 326 ft. It is a Deming Type 4700 Size 8, with gear head and horizontal V-belt pulley. An Allis-Chalmers 40-hp. Type ARX 1,750-r.p.m. 220-volt induction motor drives the pump at 750 r.p.m.

Four Buffalo No. 6E blowers, such as are shown in Fig. 3, ventilate the mine by forcing air down through four 6-in. cased boreholes. The drive of the blower shown is a 3-hp. Allis-Chalmers ball-bearing motor operating at 1,740 r.p.m. In the case of the blower pictured in Fig. 3 the mounting is 30 ft. from the top of the hole in order to be farther from the creek. The 6-in. blower discharge pipe can be seen at the right, and the top end of the borehole casing at the extreme edge of the photograph. Other blowers are at the tops of the respective boreholes.

From the power house the compressed air is piped to the underground for drilling operations. Ingersoll-Rand Type S49 drills are hand-held for stoping and mounted for heading work. Raises driven on the vein are drilled with an Ingersoll-Rand No. 85 stoper. Shooting is done with Gold Medal 30 percent gelatin dynamite in $1\frac{1}{4}$x8-in. sticks and fired by fuse and detonator.

V. G. Smith is superintendent, J. G. Trewartha general superintendent of the mill and mine, and A. G. Johnson geologist.

Fig. 1 . . . V. G. Smith, superintendent, asks Gerald Smith, motorman, how many tubs he has hauled during the shift

Fig. 2 . . . New diesel engine driving alternator and compressor

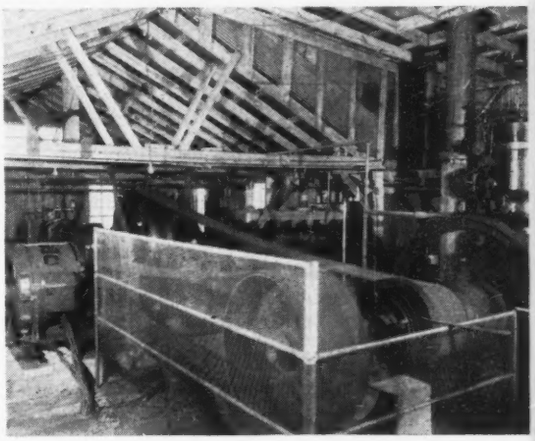


Fig. 3 . . . Four 3-hp. blowers like this one force air into the mine through 6-in. cased boreholes

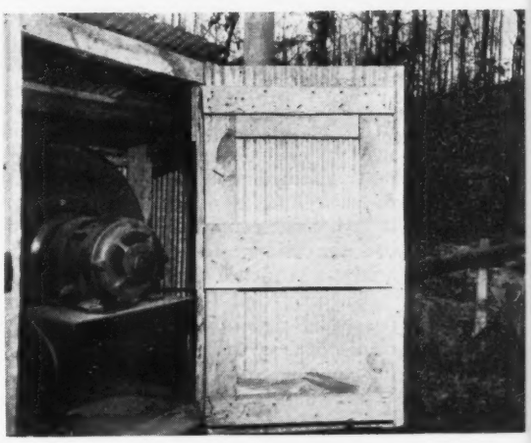
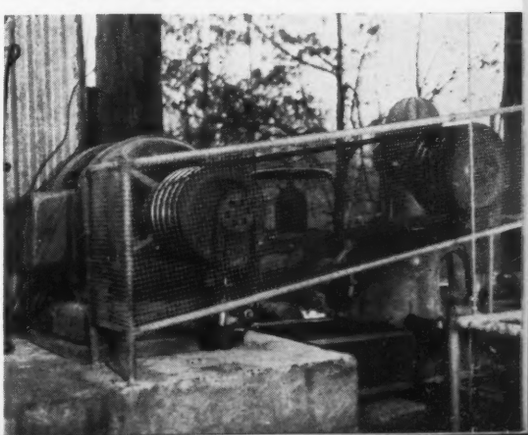


Fig. 4 . . . The mine is dewatered with this motor-driven turbine pump



When Designing Launders

How to eliminate bottom-wear and insure against clogging under given conditions

Warren E. Wilson

Professor and Head of the Department of Mechanics, Colorado School of Mines, Golden, Colo.

LAUNDER DESIGN has long been on a strictly empirical basis, rule-of-thumb methods being used for determining the dimensions of the launder. The result usually has been that adjustment has had to be made in field or plant to secure proper flow characteristics, or that the wear of the launder has been excessive when the material was carried at velocities greater than necessary.

A method of designing and constructing launders is here suggested which will practically eliminate wear of the launder bottom and at the same time insure against clogging when operating under conditions for which the design was made. It has been evolved from a study of experimental work done about 35 years ago,[1, 2] as well as from a study of the tailings disposal line of the Climax Molybdenum Co.,[3] plus an experimental check in the laboratory.

Review of available literature on launder design reveals that the determination of the required slope has generally been predicated on the assumption that size of particle or percent solids governs. However, a study of the fundamental mechanics of the flow of solids in suspension reveals that neither is sufficient alone to be the determining factor. A complete theory of such flow is not yet available, so it is best to confine the determination of dimensions to an experimental analysis to insure satisfactory results.

The principal features of the launder which will operate without appreciable bottom wear and without tending to clog are illustrated in Fig. 1. If a launder is laid with a horizontal bottom and sufficient freeboard, the flow will take place as illustrated here, the solids depositing on the bottom to form an erodible channel bottom with just enough slope to carry the load without erosion or deposition. If the solids load is increased, some solids will be deposited upstream, resulting in an increased slope which will in turn result in a greater carrying capacity of the stream, so that it can carry the larger percent solids. This phenomenon was described by Gilbert[2] in experiments 35 years ago and is observed in the Climax tailings line.[3] Obviously, if there is to be a considerable bottom slope, the use of a horizontal bottom is impractical, since extremely high walls would be required upstream. This difficulty may be overcome by first determining the slope which will be required for the minimum expected solids load. The channel bottom may then be laid on this slope, and with the installation of a sill, as shown in Fig. 2, the launder will care for flow with the minimum slope expected and with a somewhat lesser slope if necessary as illustrated also in Fig. 2.

Now if the launder is to be very long, the channel depth required at the upstream end will be excessive. A means of overcoming this difficulty is illustrated in Fig. 3. A succession of drops eliminates the necessity for very high channel walls upstream. This device, a succession of drops, has been used elsewhere. Homestake Mining Co. uses it, but for a somewhat different purpose. The pipe line at Climax makes use of this principle, the practice differing only in that the line is a closed conduit as contrasted with the open conduit here considered. As may be seen in Fig. 3a, the flow with minimum solids content, and consequently at minimum slope, will take place as shown by the channel bottom *a-b* and water surface *c-d*. With maximum solids content as shown in Fig. 3b, the flow will be bounded by the line *e-f* depicting the channel bottom and *g-h* the water surface. The drops will be in operation when the solids content is small. The exact proportioning of them will be a problem for the designer, who must consider the economics of the construction. He must balance the cost of side walls against the cost of the vertical drops. If the variation in solids content is to be small, thus requiring only slight adjustment in the slope during the period of operation of the plant, the use of the drops might well be avoided by the use of high side, walls upstream.

Determination of the slope required with a given quantity of material flowing in a launder is not yet subject to exact calculation. I expect to publish a method for such computations in the near future, but in the meantime propose that an experimental approach following closely that used about 35 years ago by Blue[1], be used.

In Fig. 4 is shown the apparatus necessary for a determination of the dimensions of a launder by experimental means. A launder 25 or 30 ft. long fed by a centrifugal pump and emptying into a hopper-bottomed tank forms the principle part of it. The launder should be so mounted that the slope may be adjusted from zero to a maximum of about 10 percent.

To determine the necessary dimensions of the channel, the width should first be estimated on the basis of past experience. Slope and depth of flow may then be determined experimentally as follows: Place in the system a mixture of the solids and liquid to be used in the proportion that gives the maximum solids content to be expected during the operation of the plant. Set the launder at the maximum slope obtainable with the apparatus. Start the pump and allow the material to circulate for a few minutes to insure complete mixing of solids and liquid. Now, if the mixture flows through the launder with no deposition of solids, gradually decrease the launder slope until that slope is found which gives a flow with solids just beginning to settle out. This slope is the maximum for which provision need be made in the actual launder of the width given and carrying the load under observation. The corresponding depth is the least to be expected.

To determine the minimum slope for which provision should be made the procedure is the same, except that the mixture of solids and liquid should be the one which carries the smallest solids load to be expected in actual operation. It is important that this minimum be determined so that the corresponding depth, which is the maximum to be expected, may be measured, thus making it possible to effect maximum economy in the design of the channel walls and to decide concerning the use of drops.

An attempt to design a launder which gives automatic slope adjustment as described, by using the values for slope given in handbooks and other literature, must be discouraged. A simple illustration of the difficulty which may be met is afforded by considering the data presented by Gilbert. Using a sand with an average grain size of 0.00123 ft. he finds experimentally that the minimum slopes required in a certain channel vary from 0.0040 to 0.0246 with the same quantity of liquid flowing but with a varia-

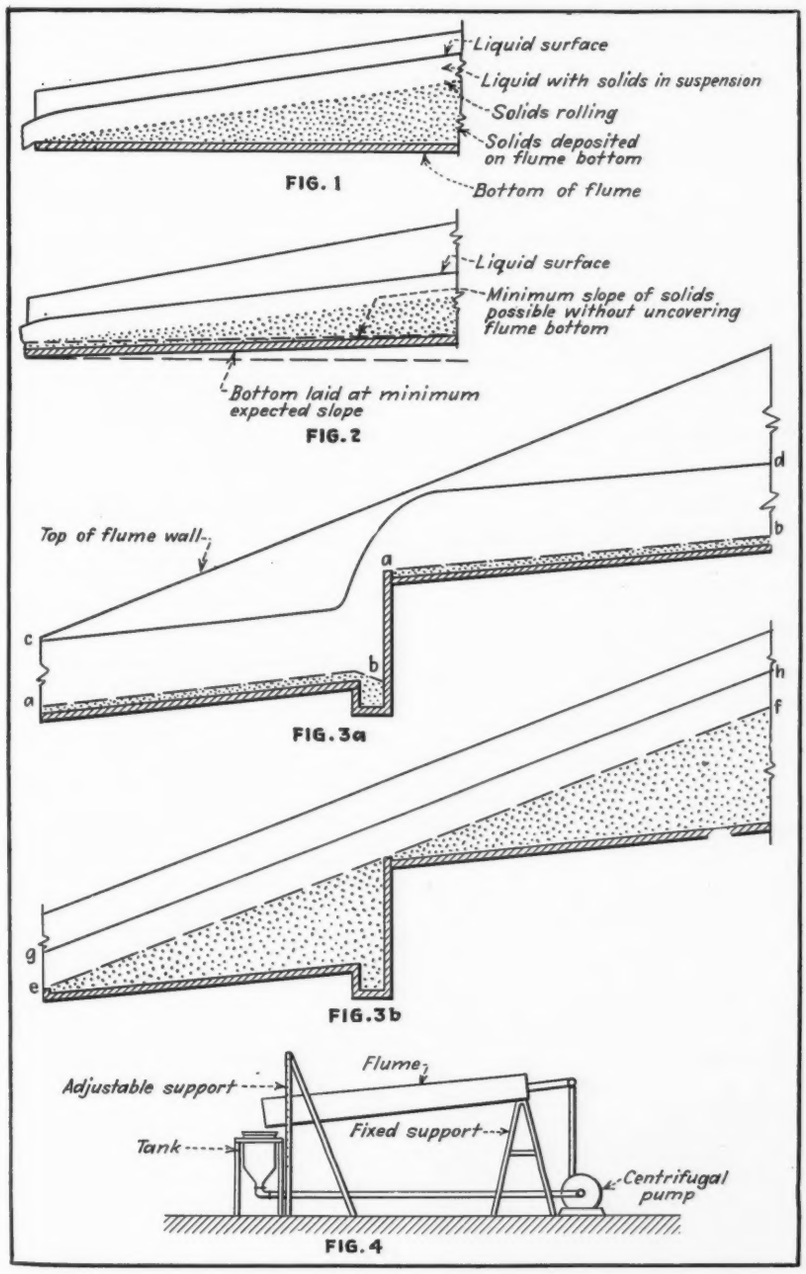
[1] For this and other references see bibliography at end.

tion in the solids content from 0.1 to 3.0 percent. Thus we see that a design based on a slope determined from the consideration of grain size only would be inadequate.

It is to be emphasized that with a properly designed channel (that is, one which provides at low flows ample freeboard to handle flows with heavy solids loads) the adjustment of bottom slope will be entirely automatic and neither erosion of the bottom nor spilling over the sides will occur. The necessity for dilution of the flow with additional water then disappears. The only occasion for concern need then be when a solids load in excess of that considered in the design is encountered. The use of the self-adjusting flume permits cheaper construction, since there is no need for using expensive steel or iron pipes for launders. Timber is adequate for a flume of this type, and it is to be expected that wear on the side walls will be a minimum, especially if relatively wide flumes with shallow liquid depths are used.

At this time it might be well to point out that there are a number of problems peculiar to the mineral industries, involving flow of liquids, which might profitably be studied experimentally. At the same time caution must be exercised in transferring the results of experiment from a small-scale study to the structure in the plant, especially when the flow involves the flow of solids in transport by liquids. It must be emphasized that the experimental procedure outlined for determining launder dimensions must be carried out on a flume having a cross-section identical with that to be used in the plant and that the solids be identical in size and shape with those in the plant. However, it is unnecessary to have a full-length launder, provided it is long enough to eliminate the effect of the intake and outlet on the flow.

In conclusion I desire to emphasize that the design suggested here is not "theoretical" in the sense that the practical man so often conceives of new approaches to an old problem. The data on which the idea is based have been in existence for many years. The Climax tailing line is a practical example of the application of the principle to a closed conduit. Actual operation of flumes with automatic slope adjustment was carried out by Gilbert in his experimental work. Laboratory investigations by me have confirmed the existence of the principle of automatic adjustment of slopes when the bottom of the channel is formed by deposition of solids. Preconceived notions concerning the carrying capacity of flowing water have to a great extent governed the previous study of flow in launders and have undeniably confused the issue. A thorough understanding of the principles of the transport of solids to the extent set forth in the accepted theories to date is desirable if one is to investigate this most difficult of fluid flow problems. Most recent publications on the subject are summarized in the accompanying bibliography.



Figs. 1–4 . . . Sketches illustrating the design of launders for meeting specified conditions

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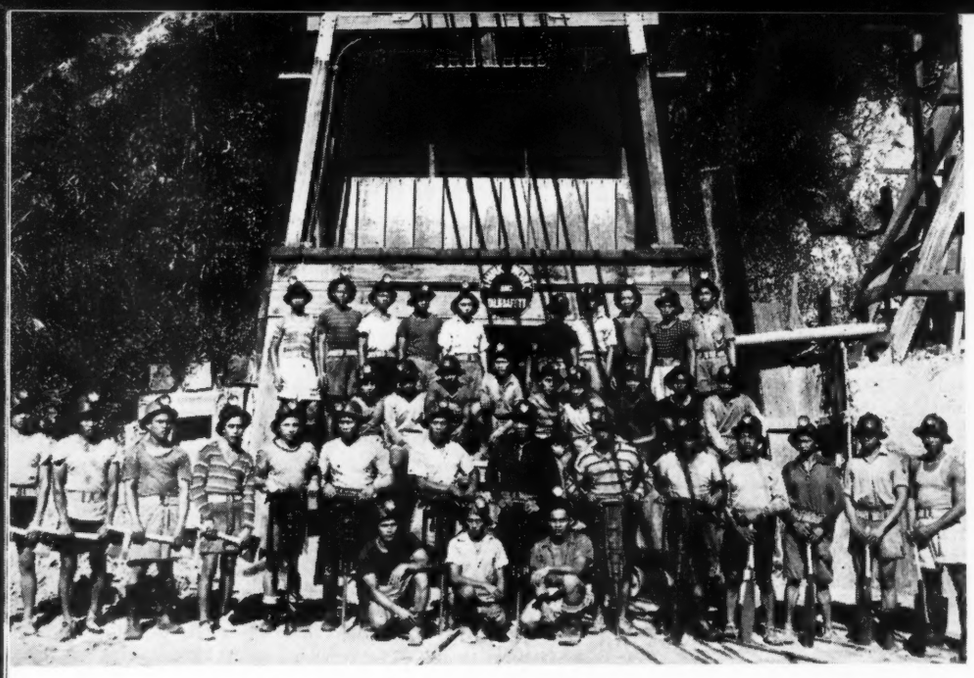


The sinking crews who have been putting down United Paracale's McDonald shaft

A Shaft-Sinking Job in the Philippines

United Paracale's McDonald shaft crews set a local record

J. C. Alexander
Mine Superintendent
United Paracale Mining Co.
Paracale, Camarines Norte, Luzon, P. I.

NOW BEING SUNK by United Paracale Mining Co., at Paracale, Camarines Norte, Luzon, P. I., the McDonald shaft is being put down to exploit two vein systems—the McDonald and the Kalaw. It is an interior shaft and is situated 1,700 ft. from the portal of the tunnel known as the San Antonio.

Sinking is under way on an 8-hour, 3-shift basis. Two mine foremen, Allan West and Arthur Harrow, supervise the work in conjunction with their regular activities. Each shift has a personnel of one *capataz*, eight shaftmen, one tugger-hoistman, one topman, and one hoistman. The entire crew is Filipino and from the Bicol region, all of the men having gained their milling experience with the company.

The shaft has three compartments, the rock section being 8x19 ft. It is timbered with 8x8-in. yacal sets, spaced 6 ft. center to center, $\frac{7}{8}$-in. round hanging rods being used. The guides are of 4x6-in. apitong timber. The lowest set is kept 40 ft. from the bottom.

The rock is hard, fine-grained granite and stands well. A 38-hole round is drilled. Blasting is done with 40 percent Atlas gelatin dynamite, using No. 1 to No. 7 electric delays. For drilling, six Sullivan wet L–57 jackhammers are employed, these having been found well adapted for this work.

Hoisting is done with a 100-hp. double-drum Joshua Hendy unit, the broken rock being brought to surface by car on a cage having extended steel guides. Rock and men are hoisted in the end compartment, the middle compartment being used for lowering the wall plates and the tugger hoist; and the third compartment serving for the manway and to carry a 6-in. discharge line, 4-in. airline, 2-in. waterline, and 10-in. ventilation pipe, as well as the cables for two 40-hp. pumps.

Mucking into buckets, which requires more than 60 percent of the total man-hours per foot, has been superseded by use of a 20-cu.ft. mucking pan. This has the advantages that rocks and coarse fragments can be rolled into it and the finer material has to be lifted only about 22 in., making for more speed and less work. The sinking equipment, with a few modifications to suit local conditions, is a duplicate of that used in sinking the Turayog shaft of San Mauricio Mining Co., also in Camarines Norte.

When the mucking pan is loaded, it is hoisted with a Sullivan Model L-111 reversible hoist mounted in the center compartment about 50 ft. above the bottom and operated by a hoistman. The bail is so attached that the pan will balance when off the bottom and requires little effort to dump it. The cage is constructed with an opening on the side to permit dumping the pan into the car.

The rock is hard and firm. Four rounds are drilled and blasted before timbering. The four sets are then blocked in position in 8 to 10 hours, during which time all pipes and ladders are extended. The tugger hoist is lowered to a new position every 50 ft.

The cycle of operations is as follows:

Drilling a 7-ft. round	2 hr. 45 min.
Loading and blasting	1 hr. 45 min.
Blowing out smoke and gases and cleaning wall plates	1 hr.
Mucking out an average of 90 tons broken per round	14 hr.
Timbering, per set	2½ hr.
Total	22 hours

The remaining two hours in the 24-hr. day are consumed in lowering and hoisting the sinking pump, installing pipe, and doing miscellaneous tasks.

A total of 188 ft. was sunk in 30 days, an average of 6.27 ft. per day, including the placing of bearers and station sets on the 150-ft. level. This is considered a record for sinking in the Philippines.

Commendation is given to the two foremen mentioned and to Charles Fletcher, mechanical and electrical superintendent, and his staff, the latter for excellent cooperation. The highest praise is due the shaft crews, whose work, enthusiasm, and determination made this record possible without serious accident.

Another shaft of United Paracale—the Longos headframe at right center

Coco Grove Dredges Have Interesting Features

The all-steel boats of this Philippine enterprise were specially designed

G. R. Johnson
Coco Grove, Inc.
Paracale, Camarines Norte
Luzon, P. I.

► THIS CONTRIBUTION *was received two months before the Japanese invaded the Philippines. Since the outbreak of war no information has been received as to the situation now surrounding the author, his associates, and the company itself. This circumstance may lend special interest to the article, which is wholly technical in character. Mr. Alexander's article opposite is published under like circumstances.*

COCO GROVE, INC., operates two modern 8-cu.ft. all-steel bucket-line dredges in the Paracale district on Luzon, in the Philippines. It owns or controls about 2,500 acres of placer ground and is managed by Marsman & Co., Inc., of Manila.

The Paracale district has been the scene of placer mining since the Chinese worked there during the Ming Dynasty. Coco Grove started in 1934 with two suction dredges and one bucket-line dredge, all built for harbor work. These dredges were not very efficient for the work, and it was decided to buy standard gold-saving bucket dredges. In January and February, 1938, the present dredges started.

These dredges work both virgin ground and tailings. Most of the work has been on the Paracale delta and in Paracale Bay, into which the river empties. The town of Paracale is at the latter's mouth. This is almost an insignificant stream and drains a very small watershed, from which came the gold found in the gravels in the bay and in the delta. Since October, 1940, one of the dredges has been working in the Malaguit River, which runs roughly northeast and empties into the ocean through Malaguit Bay. This river is wide and the tidewater backs up several miles. The dredging is two to three miles southeast of Paracale.

Coco Grove has three different types of dredging situations: (1) in a nearly landlocked pond; (2) in the ocean foreshore; and (3) in fairly swift water, as in the Malaguit River. All operations are within tide range and the level of the pond moves up and down with the tide.

The company has two identical dredges, which have been named the "Mary Angus" and the "Anne Petronella." These were designed in conjunction with our engineers and supplied by Bucyrus-Erie Co. They are all-steel boats equipped with 8-cu.ft. Amsco rivetless-lip buckets. Their normal capacity is 165,000 cu.yd. per month each. They are suited for work on either spuds or headline. The hull is 152½x60 ft. and 9 ft. deep. Normal freeboard is about 4 ft., which is comparatively large but necessary when working in the foreshore area. The bucket line has 106 buckets and can dig 65 ft. under the surface of the water. It is driven by a 200-hp. induction motor connected to the single bull gear by a gear train. The digging motor sits just aft of the dump hopper. Between motor and bull gear are two intermediate shafts to reduce the speed from 692 r.p.m. to 4⅓ r.p.m., giving the bucket line a speed of 26 buckets per minute. The motor is connected to the high-speed pinion by a flexible coupling. In the gear train between the motor and tumbler on the first intermediate shaft is an overload slipping friction which protects the motor against shock and overload.

The screening and washing plant consists of an 8-ft. diameter trommel with 33 ft. of perforated screen plates and double-deck tables equipped with angle-iron Hungarian riffles. Table tailings pass out over the tail sluices. Trommel oversize is discharged onto the stacker conveyor. The perforations in the screen plates are round and tapered, being slightly larger on the outside to prevent stones from lodging in the holes. These are ¼ in. in diameter on the inside of the plate at the upper end of the screen, increasing to ⅝ in. diameter at the lower end.

On the main deck, port side, is the ladder winch. It is equipped with a 150-hp. variable-speed induction motor, power braking for stopping the ladder after a drop, and a thrustor brake on the motor shaft to hold the ladder in place when the controller is "off." The motor drives the drum through a train of gears.

The swing winch is on the starboard side of the main deck under the winch room. It has three wide drums and six narrow ones. Head line and bow-swing lines are on the wide drums. The narrow ones are for two spud lines, two stern lines, and two spare lines. A jaw clutch is provided for disengaging the rest of the winch when only the bow lines are being used. All the clutches and brakes on the swing winch are operated by an hydraulic system with the control levers in the winch room. The swing winch is driven by a 30-hp. variable-speed induction motor. The motor drives the winch through a train of gears. Bow lines pass from winch to sheaves on top of the front gantry, thence to water-lubricated, well-housed and hinged sheaves on the side of the ladder near the lower hanger support, thence to deadmen on the banks of the pond.

A 40-hp. variable-speed induction gear-motor drives the stacker, the head pulley being driven through a roller chain, with a small sprocket on the motor shaft and a large sprocket on the head-pulley shaft. The stacker belt is 42 in. wide by 330 ft. The hinged part of the stacker is 107 ft. long.

The pumping plant consists of two

General view of Coco Grove compound, in the middle distance across the Paracale River, which empties into Paracale Bay at the right. At the mouth is the suction dredge "Rotterdam." In the upper right corner is the gold dredge "Mary Angus."

5-in. centrifugal pumps and two 12-in. centrifugals. In addition there is one 3-in. bilge pump for dewatering the compartments in the hull. The two 5-in. pumps are used to furnish water for the nozzles in the dump hopper, for the deck hoses, and for clean-up. The two 12-in. pumps are identical, but one is connected to a 150-hp., 1,150-r.p.m. motor and delivers 4,500 g.p.m. at 100-ft. head to the nozzles inside the screen. The other 12-in. pump is connected to a 60-hp., 880-r.p.m. motor and delivers 4,500 g.p.m. at 35-ft. head for the extra table water needed.

Characterizing the design of the dredges is the extensive use of roller bearings on all high-speed shafts on both winches and main drive. Another element is the use of gears instead of belting on the motor drives and that of gear-motors on the stacker and screen. There are no flat transmission belts nor V-belts on the dredges, save on the compressor.

Several extraordinary features mark the design of these dredges: The dump-chute bypass is a hinged door in the bottom of the dump hopper. When closed, it forms a part of the hopper bottom. The bucket-line discharge passes from the hopper directly into the trommel. When the door is open, it passes through it and down a steeply inclined chute to the stacker belt, thereby not going through the screen and over the tables. The inboard end of the stacker belt passes over a stationary frame on the main deck back nearly to the wellway. The bypass design was necessary because of the presence of 20 to 35 ft. of sticky clay above the gold-bearing gravel. This clay cannot be broken up in the screen, and if permitted to pass over the tables, would "rob" them of gold already caught. When the dredge is digging this clay the trap door is always open.

Another unusual feature is the clay digger, a device for digging the material out of the buckets as they come over the upper tumbler. The sticky clay and some of the pay dirt, especially the decomposed granite bedrock, will stick to the lip of the bucket unless some means is provided for cleaning it off. The digger is essentially a horizontal shaft parallel to the upper tumbler shaft. It is above and slightly to the stern of the latter, about 12 in. away from the edge of the bucket lips as they pass over the tumbler. On this shaft are mounted at 120 deg. three arms about 3 ft. long, each having its end flattened like the blade of a spade. As a full bucket comes over, one of these spades is in such a position that it is forced into the clay at a point near the middle of the lip. As the bucket moves down, it pushes against the arm, making all three arms rotate. This causes the spade inside the bucket to eject the clay from it and brings the next arm into position. On the digger shaft is a three-sided cam on which rides a weighted follower. This causes the arms to stop at the right place. The entire apparatus is mounted on a heavy frame hinged ahead of and above the upper tumbler so that it can give if one of the spades strikes a rock. The stern end of the frame rests on blocks aft of the hopper opening. The frame is also provided with an air-cylinder shock absorber so that when it gives for any reason it will return gently to rest. No power is required for the digger, the bucket line doing the work. When it is not needed the end of the frame is raised with a block until the arms clear the buckets.

A third unusual feature is the method of supporting the upper end of the digging ladder, which is done concentrically by the upper tumbler shaft. The points of support are on each side of the tumbler, between it and its shaft bearings. The shaft turns inside the ladder brackets on roller bearings.

Still another feature is the roller-bearings-mounted lower tumbler. This turns on the shaft, which is held tightly between the lower jaws, serving to keep them rigid better than is done with the usual tie rod. There are two radial roller bearings, one on each end of the tumbler, and one two-way tapered roller thrust bearing next to one of the radial bearings.

The fifth and last unusual feature is the method of supporting and driving the trommel. The upper end is carried in the usual manner by a large tire, a few feet back from the end, running on two rollers. At the lower end the ends of the ribs are welded to a 10-ft. diameter disk-shaped casting the plane of which is perpendicular to the screen axis. On the stern side of this casting is a hollow shaft protruding from the center which is supported by a self-aligning, combination thrust-radial, tapered roller bearing. This carries the lower end of the screen and resists the downhill thrust. Through the hollow shaft passes an 8-in. water pipe which supplies the lower spray inside the screen. The screen is driven thus: On the after side of the disk-like casting is bolted a 6-ft. gear, which is driven by a pinion on a 42-r.p.m. 60-hp. gearmotor mounted on the starboard side behind the screen.

Screen oversize leaves through the section just ahead of the driving disk. There are no plates here, and the oversize drops through. The screen ribs are of seamless-steel tubing $\frac{7}{8}$ in. thick and $6\frac{5}{8}$ in. in outside diameter. The screen runs at 6 r.p.m.

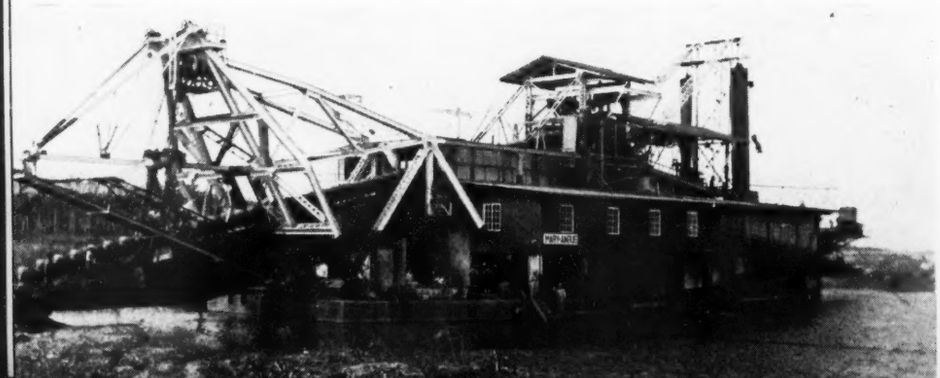
A piece of equipment not built into most dredges is the stationary boom on the forward side of the bow gantry. A set of blocks on its end hangs directly over the lower tumbler when the ladder is lifted, so that it can be used to handle the tumbler if necessary. This is advantageous when the dredges have no bank in front of them.

Considerable auxiliary equipment is required. The principal items are a 24-in. suction dredge of the sea-going type and a 450-hp. tugboat. The former is used to maintain a safe harbor in the mouth of the river for refuge when a typhoon threatens. The tugboat serves for towing the dredges when necessary and for moving the anchors to which the headline and side lines are attached. Sometimes a 5-ton steam crane mounted on a large barge is used to pick these up. At times the dredges have worked more than half a mile from the harbor. Present practice is to operate in the bay only from June to October, when it is comparatively calm. The dredges can work in a moderate swell, but when the bay gets too rough they have to shut down until the water becomes calmer. Up to the end of 1940 there had been no typhoons while the dredges were working in the bay. Two have hit the Paracale district, however, since the dredges were installed. The first was in 1937, when the dredges were being assembled, and some damage was done. The second was in December, 1940, when many power lines were blown down and some roofs taken off. The dredges suffered only slight damage to the corrugated-iron housing.

A modern machine shop on the property makes many spare parts besides attending to dredge repairs. Electric welding plays a big roll in such repair and maintenance work. The company owns five portable electric generators and one gasoline-driven generator. Electric power for the operations is furnished by a plant owned and operated jointly by Coco Grove, Inc., and United Paracale Mining Co. The power is delivered to the dredges at 6,600 v., 3 phase, 60 cycles, a.c. On the dredges it is stepped down to 440 v. for the motors and 110 v. for the lights.

Gold-saving equipment consists of double-deck transverse tables and

A close-up view of the gold dredge "Mary Angus," working in old tailings



Coco Grove staff members. Left to right, sitting: C. Geear, dredgemaster, "Anne Petronella"; J. L. Griffin, dredgemaster, "Mary Angus." Standing: G. R. Johnson, the author and gold-recovery supervisor; G. Jaquet, gold-table shifter; O. H. Clark, accountant; F. A. Nowacki, general superintendent; E. E. Lemon, winchman; Th. Gundersen, winchman; H. G. Hornbostel, amalgamation plant foreman. Not shown in picture; T. P. Shuttles, gold-table shifter; J. A. Smakman, master mechanic; and M. Nemoff, gold-table shifter. On the chair is 76,000 pesos ($38,000 U. S.) in gold bars

Winchroom on the "Mary Angus"

partly double-deck longitudinal tables. There are 21 transverse tables on each side. These are 18 in. wide. They deliver to five longitudinal tables 30 in. wide, which discharge onto the tail sluices. In the first 15 ft. of the sluices are wood-block riffles, 2 in. square by 3 in. high. The tables all have angle-iron Hungarian riffles. Table area totals nearly 4,000 sq.ft.

The save-all has four tables 18 in. wide by 8 ft. long running toward the stern. These deliver to four other tables 9 ft. long that run forward and discharge into the wellway. The save-all grizzly bars are spaced $\frac{3}{4}$ in. apart.

The physical character of the gold varies considerably in different parts of the area. That found in the upper part of the river and along the sides at the foot of hills is coarse, with many small nuggets. Here much of it is still attached to quartz. Farther away from the hillsides and out in the bay the gold becomes very fine.

Table clean-up is carried out as follows: The riffles are taken up and the sand from the top deck of the double-deck tables is thrown on the lower deck and washed down with a gentle stream of water. All amalgam, mercury, and black sand are put into buckets; the rest is washed down to a trap door at the lower end of the longitudinal sluices, whence it passes into a big hopper. Between 1,000 and 2,000 lb. of material is picked up from the tables and carried in locked buckets to the amalgamation plant. Here it is passed over a long tom 30 in. wide, which is a steel sluice, at the upper end of which the buckets of gold-table concentrate are dumped and washed down, one at a time. Most of the amalgam stays in the bottom where the buckets are dumped, the sand being washed away. The concentrate must pass through a mercury-filled trap, thence over 48 in. of silver-plated copper plate, across another trap, then back into the buckets and is saved for milling. Some amalgam is caught in the trap and some gold amalgamates on the copper plate. Plate and trap have to be cleaned after three to ten buckets, depending on the amount of amalgam.

The concentrate that is washed into the hoppers receives different treatment. A dewatering drag in each hopper raises the material and feeds it into a hydraulic classifier which catches any mercury or amalgam. From here it goes over two 18-in. Crangle water-pulsated jigs in series. The jig tailings pass over a riffle-lined sluice and then into the pond. These jigs make a hutch product consisting principally of black sand or pyrite or both, if any pyrite is present. This hutch product usually contains free gold also. The jigs have a $\frac{3}{16}$-in. square opening in the screens. A bed of plus $\frac{1}{4}$-in. minus $\frac{1}{2}$-in. pieces of magnetite is used and is satisfactory. There are three products from the jigging: (1) hydraulic-classifier concentrate, (2) jig concentrate, and (3) jig bedding. They are all taken to the amalgamation plant, where the hydraulic-classifier concentrate and the jig bedding are hand-panned to separate amalgam and nuggets.

Next, the jig concentrate, the gold-table concentrate, and all the other material brought in from the dredge is milled in a 42 by 48-in. Denver Equipment Co. amalgamation barrel. This contains 1,000 lb. of 3-in. and 2-in. steel balls and the charge of concentrate is 900 to 1,000 lb. Lime, lye and sometimes ammonium chloride and used cupels are added, to condition the charge. The barrel is rotated at full speed until the balls are heard cascading, after which rotation is continued for one hour. Then the mill is opened and 8 kg. of mercury and 300 to 600 grams of NaCN are added. The mill is then closed and run at half speed for one hour. It is next discharged into a hydraulic classifier, the overflow of which passes over the long tom. It then goes over a half-size Wilfley table, which separates the mercury that has traveled that far. The tailings contain 0.5 to 1.5 oz. gold per ton and are sent to a nearby mill for treatment. Roughly 20 percent of the total amalgam is recovered from the concentrate treated by the barrel. The rest comes from the gold-table concentrate and is separated by the long tom before milling.

Retorting and melting are usually done twice a month. The fineness of the gold averages about 850, but has been as low as 770 and as high as 913.

Dredging costs, including capital development and other capital investments, depreciation, taxation, insurance, handling and shipping of bullion, and other items amount to about 12c. (U. S.) per cubic yard. This compares favorably with costs on other foreign dredging work. Factors contributing to the expense that might not be incurred in other operations are (1) necessity of maintaining a large inventory of supplies and spare parts; (2) the operation and maintenance of the suction dredge, the tugboat, one or two launches, and miscellaneous other pieces of floating equipment; (3) repainting both dredges and all floating equipment twice a year (necessary because of the terrific corrosive action of salt water); and (4) maintaining a comfortable camp for staff members.

The staff consists of 14 men: General superintendent, two dredgemasters, four winchmen, one gold-recovery supervisor, three gold-table shifters, one amalgamation-plant foreman, a master mechanic, and an accountant. A photograph of the staff is shown.

Acknowledgment is hereby made to F. A. Nowacki, general superintendent, for suggestions, and for much of the information herein.

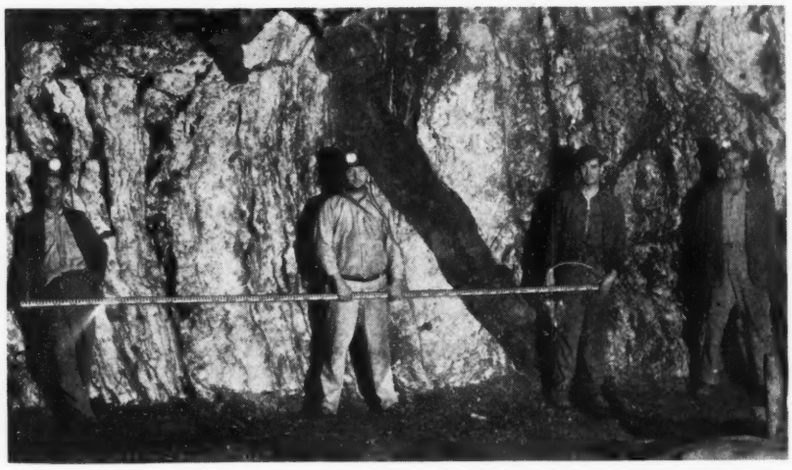
A Lode Gold Mine in Colombia

Vein worked by Timmins Ochali company in Antioquia was long sought but defied discovery until 1929. Underground operations are described

LEGENDARY TALES passed on by Indians still inhabiting northwestern Antioquía, in Colombia, and information reported to have come from early Spanish archives of a mine in the area now occupied by the Timmins Ochali Mining Co., at Yarumal, prompted many parties of prospectors to search for a vein. Between 1918 and 1929 there were four reported expeditions, all of which found gold in the streams but failed to uncover or recognize the lode. Not until late in 1929 was the vein found by Don Alfredo Orosco, a rancher in the neighborhood. He formed a small company among friends and neighbors, each contributing his share, either in food and equipment or in rudimentary mining knowledge. Title was obtained to the original Berlin claim, and, later, its four bounding continuations were also titled. A small wooden stamp mill was built and production started in April, 1930, on a modest scale.

Late in 1930 a section of the mine was leased to a small local company, and another to a second company early in 1931. Each installed a wooden stamp mill with an overshot water wheel and a sand-leaching plant for cyaniding the tailing. Ore was taken from an open cut just above the portal of the 1,930-meter level and from a few short drifts driven in from the outcrop in an area above the present 1,960-meter level.

Representing the N. A. Timmins Corp., the property was examined in June, 1933, by Everard Leland, managing director of the present company, with his assistant, George Gonzalez, now comptroller. The result was sufficiently encouraging to justify further underground exploration. An 18-month option was taken and development started by hand methods in August. At the end of 1933 two gasoline compressors were installed to operate three mounted jackhammers and a stopehammer. By the end of 1934 4,910 ft. of development had been done, blocking out 229,000 tons of 0.58-oz. gold ore. The property was bought Jan. 11, 1935, and a 100-ton all-slime cyanide plant planned.



Mining out "sill cut" in wide section of vein, illustrating banded characteristics of ore with felsite dike in center of vein

Forbes K. Wilson
Manager

Balfour F. Darnell
General Superintendent

Timmins Ochali Mining Co.
Yarumal, Antioquia, Colombia

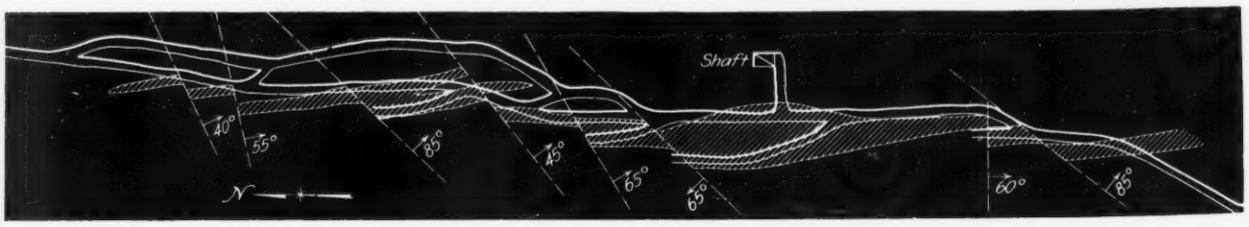
Prior to purchase, work had been begun on a 34-mile tractor road through mountainous country running from Yarumal to the mine. The first load of equipment arrived in September, 1935, and the original mill was started in May, 1936. Underground development soon justified as increase in mill capacity, and two additional 100-ton units were placed in operation early in 1938. Total capacity has since been gradually increased to 390 tons per day by making small changes in the flowsheet.

The claims are in rugged country constituting part of the central range of the main Cordillera. This location is approximately 7 deg. north of the equator. The camp is 6,000 ft. above the sea and the climate uniform and semi-tropical. Annual rainfall averages 120 in., most of this falling in the wet seasons of early spring and late fall.

The original leasing companies produced 11,170 oz. of fine gold from 1930 to the end of 1934. During 1935 and the first half of 1936 the present company operated the old equipment until the first 100-ton unit of the new mill was completed. This accounts in part for the low percentage of extraction given for those years in Table I on page 65.

Geology—Mining rights are held on 25 claims extending over a 3-mile stretch and comprising 1,850 acres.

Fig. 1. . . Plan of 1,860 level on south orebody, showing post-mineral faulting



These claims are laid out along the north-south strike of the local rocks covering the contact of two schists which dip 50 to 80 deg. east. The main vein occurs on or near this contact, which has been traced over the entire stretch. Commercial ore occurs in three places. Parallel to the contact and 200 to 800 ft. in the hanging wall there is a granite intrusive, 3 miles wide and extending well beyond the claims to the north and to the south.

The schists are argillaceous sediments, highly altered by dynamic metamorphism and subjected locally to hydrothermal alteration by solutions which brought in varying amounts of quartz and carbonate with minor amounts of sulphides. They are locally known as the "hanging-wall" or "black" schist, which is a carbonaceous chlorite schist, and the "footwall," or "gray" schist, which is a quartz-sericite schist similar to the former but without carbonaceous material. The former is apparently the favorable zone for ore deposition, and to date only minor spurs from the main vein have been found within the footwall schist.

The orebodies occur in a large vein of quartz varying in width from a few inches to 80 ft. deposited along an old fracture near the contact. At the time of deposition, inclusions of hanging-wall or carbonaceous schist, in amounts and sizes ranging from scarcely discernible specks and thin films to lenses several feet wide and 50 ft. long, were retained in the quartz. Subsequent ground movement in the walls induced movement within the vein wherever there were planes of weakness in the form of schist inclusions. The spaces thus opened in turn formed channels for later mineralizing solutions which partly replaced the schist inclusions and deposited most of the gold. The oreshoots are thus localized to sections containing abundant inclusions. The ore has a characteristic banded appearance, with the gold and sulphide concentrated along the inclusions, either on the schist wall or in the quartz immediately adjacent. Solid quartz without schist inclusions is invariably below the commercial limit.

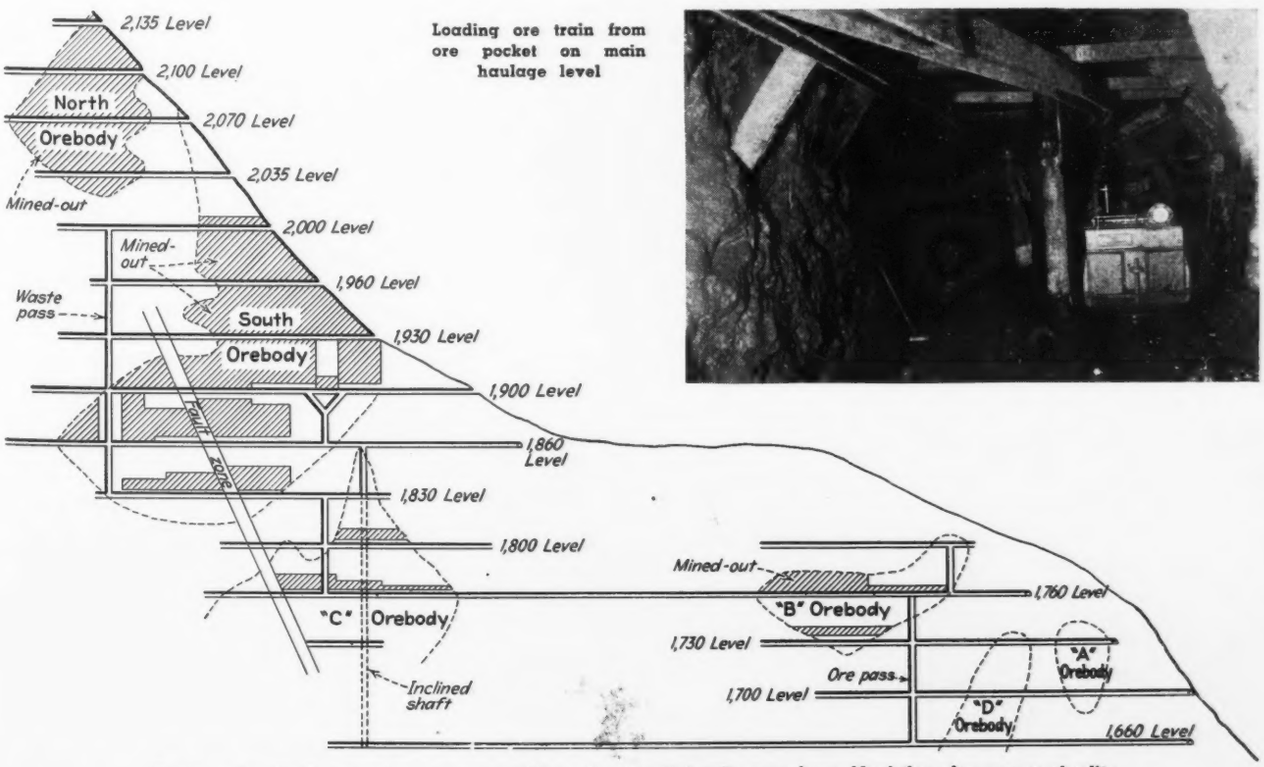
Gold occurs free in minor amounts and mechanically associated with the principal sulphides, including pyrite, galena, and sphalerite. There are also minor amounts of pyrrhotite, arsenopyrite, and traces of chalcopyrite. Small seams of late marcasite occur in the mine but are probably unrelated to the period of deposition.

Underground exploration has been done over a length of 4,000 ft. and a vertical range of 1,600 ft. In this area seven oreshoots have been found. The major orebody is a lens having a maximum length and height of 800 ft., with an average width of 15 ft. Distribution of values throughout each orebody has been uniform, with a slight increase in grade on the north and upper limits, where the orebodies are usually limited by "pinches" in the vein quartz, and an assay limit on the south and lower ends, where the bodies "finger out" in low-grade quartz.

Considerable post-mineral faulting of the vein is shown by the plan of the 1,860 level on the south orebody (Fig. 1). A felsite dike, apparently representing the end phase of igneous activity, runs either parallel to or in the vein, cutting through some of the post-mineral faults and in general following an old fracture or plane of weakness in the hanging wall or in the vein itself.

Sampling—A sampling crew of five works under the engineering department's direction. Development drifts in quartz are channel-sampled over drift width at 5-ft. intervals. Crosscuts in quartz are channel-sampled along both sides in 3-ft. sections, and the assay results are averaged. Raises in quartz are channel-sampled at 5 ft. intervals on both sides at right angles to the strike of the vein. Grab samples are taken from each car to separate development muck into ore and waste. The crew occasionally cuts channel samples in stope faces in doubtful areas as a guide to stoping.

During the original development work and before purchase bulk sampling methods were used in all headings. One-twentieth of all muck produced was deposited on special sample platforms near headings, where it was broken down and reduced by coning and quartering and alternate shovels. The volume of the sample was controlled by installing a box of 1 cu.ft. capacity on the end of a 20-cu.ft. mine car, every twentieth shovelful being placed in the box. Thus the sample obtained on the platform from a 5-ft.



Loading ore train from ore pocket on main haulage level

Fig. 2. . . Longitudinal section of mine workings showing 15 levels opened up, 13 of them by means of adits

advance amounted to approximately 1 ton. On this work close supervision was required, and the assay results obtained on ore so developed checked exceptionally close with actual production from subsequent stoping in these areas. The uniform distribution of values in the ore has made such close work unnecessary in actual operation.

Stope production is sampled by grab samples taken at the stope chute by the trammers, the amount being a generous handful from each car. The sample is placed in a special container. All underground samples are sent to the assay office at the end of each shift, about 40 samples per day being handled from this source. Development samples are assayed in duplicate.

All high or erratic assays on both development and stope samples are cut to an empirical figure of 1.6 troy ounces. During the past three years, in which time 333,000 tons has gone to the mill, the calculated mine production, based on these sampling methods, has averaged 0.009 oz. per ton, or 2 percent, under the actual assay head obtained in the mill from gold shipped.

Ore Estimation—Reserves are adjusted annually to correspond with development and extraction. Grade of inactive areas, such as ore-pass pillars, is adjusted when additional data from adjoining stopes show such changes justified. Reserves are divided into two classifications, "developed" and "probable."

Developed ore includes all ore delimited on two adjacent levels, in which case the ore is assumed to be continuous between levels. The tonnage in developed sections is calculated from engineers' measurements by means of a factor of 2.75 tons per cubic meter of ore in place. Ore of a grade of 0.22 oz. and above is considered minable.

Ore is classified as probable if opened up on one level only, in which case it is assumed to extend 30 ft. above and below the level. No ore is included in reserves, either developed or probable, beyond the face of any drift or crosscut.

Levels are divided into blocks, bounded on each end by crosscuts, which in the wider sections are driven at 50-ft. intervals. In computing the grade of different blocks on a level, only the crosscut samples are used, plus the drift samples at the mouth of the crosscut. All crosscut samples are weighted in proportion to the width of vein represented.

The area in a block is computed by multiplying the distance between crosscuts by one-half the sum of the length of the two bounding crosscuts. The total ore area on each level is the sum of the areas of the individual blocks, and the average grade of the level is found by combining the average grade of the individual blocks in proportion to their respective areas.

Development—The vein strikes approximately due north at right angles to a high, steep ridge, which makes original development relatively simple by adits. To date 13 levels have been opened from surface and two from an internal shaft which runs from the 1,860 or mill haulage level to a pocket below the 1,730 level (Fig. 2). The ground so opened represents a vertical range of 1,600 ft. The average level interval is 115 ft. All levels are designated by their elevation in meters above sea level; crosscuts and working places by their north-south coordinates.

Intermediate levels, where ore is bypassed to a haulage level, are driven in the vein wherever possible, crosscuts being turned off east and west from the drift at 50-ft. intervals along the strike. From this information ore is blocked out and future stoping planned. To allow for the mining later of the drift section and sill pillar from the stopes coming up from below, a replacement or permanent drift is driven in the hanging-wall schist 50 to 75 ft. in the hanging wall of the ore. From this drift, which is also used for distributing fill, crosscuts are driven back to the fill raises of stopes advancing from below. All waste produced in hanging-wall drifts is used for stope filling. The replacement drift is driven in the hanging wall because swelling ground is usually met in the footwall schist, making timber replacement costly.

Main haulageways, of which there are three at 360-ft. intervals, are driven in the hanging-wall schist at a reasonable distance from the vein. From the haulageway, ore is delimited by means of crosscuts or diamond-drill holes. Subsequent drifting on the vein is limited to sections of positive ore.

Intermediate and replacement drifts are driven 7½x5 ft. and timbered as the ground requires. Main haulageways are driven 8x6 ft. and timbered with local 10-in. round timber, 7-ft. posts, 4½-ft. caps, and lagging of 4-in. and 6-in. round poles. These sets are placed at 5-ft. intervals.

Drifts are driven with Ingersoll-Rand L-74 machines mounted on 3½-in. columns with either 3- or 5-ft. universal arms. In driving the 1,660 level, a locally designed jumbo, mounting two drills, was used with success. Rounds are drilled 4½ to 7 ft. deep, with either a horizontal wedge cut or pyramid cut, depending on the ground. Hand mucking has been used on most of the intermediate levels. The lower levels are equipped with two Model 11 and one Model 12B Eimco Finlay loaders, which have increased the speed of driving. In vein quartz or silicified wall rock the round is loaded with 60 percent gelatin in 1¼x8-in. sticks. In softer ground 60 percent gelatin is used in the cut holes and No. 2 gelex in slash holes and relievers.

Standard 7x5-ft. crosscuts are driven across the vein in areas from which drifts subsequently may be started either north or south in ore. Small-section crosscuts, 4x3 ft. and not over 60 ft. long, are driven either by hand or by hand-held jackhammer to prospect the vein and to confirm doubtful areas that have been diamond drilled. The latter type costs $2.50 to $3.50 per foot of advance.

Ore-pass and fill-hole raises are driven with I-R SA-90 Stopehamers 4x7 ft. in average section at angles of 55 to 80 deg. All raises are divided to form separate ladderway and chute compartments. The lagged division strip and ladders are advanced with the raise, and the top of the manway is protected by a bulkhead to divert muck into the chute. Raises usually connect with short winzes sunk from the level above.

Advantage having been taken of the terrain in opening levels by adits, up to now winzes and shafts have been of minor importance. There is one internal 5x9-ft. inclined shaft running from a pocket above the 1,860 mill-haulage level to another below the 1,730 level.

The shaft has two compartments formed by a strip lagged with 2-in. plank on 4x6-in. stringers hitched into the walls. The 5x5-ft. skip compartment accommodates a 32-cu.ft. skip running on 30-lb. rails. The 5x4-ft. manway has offset ladders under which run two 4-in. air lines, one 2-in. water line, and a 3-in. drain pipe which discharges into the ditch running to surface on the 1,760 level. A 1- to 1½-ton

Cut-and-fill stope being mined out to surface. Shows "umbrella" stulls

Table I—Milling Results, 1935-1940 Inclusive

Year	Tons Milled	Grade, Oz.	Extraction %	Oz. Fine Gold Produced	Cumulative Ounces Produced
1935	8,869	1.041	71.00	6,584	6,584
1936	17,447	0.855	88.27	13,301	19,885
1937	35,224	0.632	95.39	22,011	41,896
1938	75,945	0.453	94.95	33,180	75,076
1939	115,486	0.380	96.24	43,930	119,006
1940	128,533	0.408	96.65	51,501	170,507

Table II—Driving Costs, 1,660 Level

Size of drift, 8x6 ft.; Timbered, with sets on 5-ft. centers
Drive started Aug. 1, 1940, completed June 1, 1941.

Total length of drive, ft.....	2,746
Total machine-shifts	540
Average advance per shift, ft...	5.08
Pounds of powder used.....	26,417
Pounds of powder per foot of advance	9.62
	Cost/Ft. $ U.S.
Dynamite and caps.....	2.144
Fuse	0.149
Labor drilling, mucking, and timbering	2.765
Laying track and pipe.....	0.396
Shop work	0.152
Timber	0.748
Timber repair	0.039
Vent pipe	0.255
Drill steel and sharpening.....	0.323
Machine parts	0.125
Cost of jumbo.....	0.146
Upkeep on Finlay 12B shovel..	0.050
Compressed air	0.249
Engineering	0.105
Supervision	0.288
Total	8.927

loading cartridge is located at the pocket on the 1830, 1760, and 1730 levels. Ore from intermediate levels is bypassed to the pocket below through ore-pass raises. Only ore and materials are handled in this intermediate incline, which is served by a 75-hp. single-drum Clyde hoist operating at 450 f.p.m.

To handle ore mined near the surface on the levels below the 1,760 and to service the portals of these levels, a double-drum semi-automatic 50-hp. Ottumwa hoist is used on a 1,200-ft. surface incline, of 35 deg. slope, running from a bin below the 1,660-level portal to a pocket 300 ft. east of the mill and directly above the 1,860 mill-haulage level. Skips of 1½-ton capacity are operated in balance over a three-rail system with four rails at the mid-point passing section.

Stoping—Horizontal cut-and-fill was selected as most suitable under the conditions of relatively large vein widths and weak wall rocks. This method allows complete extraction with minimum dilution, as waste rock from walls and vein inclusions can be readily sorted and used for stope-filling. Development can also be done in the walls during stoping, and the stope can be converted to a modified square-set-and-fill in faulted areas and for mining the ore below the drift on the level above.

A small amount of incline cut-and-fill has been done in sections where the vein is narrow, walls are strong, and development has indicated no possibility of parallel or spur veins.

Derivation of tons mined in 1940 by mining method is as follows: development and stope advances, 18.4 percent; horizontal cut-and-fill, 51.5; Square-set-and-fill, 25.6; incline cut-and-fill, 4.5.

In laying out stope blocks in developed areas attention is given to known faulting. Fault planes on which displacement is more than half the vein width are used wherever possible as the north or south stope boundary. Operating experience has also indicated that individual stopes should not exceed 120 ft. in length or 3,600 sq.ft. in area. To prevent weakening the walls, with consequent subsidence on the hanging-wall drift on the level above, adjacent stopes must be kept at least three cuts, or roughly 20 ft., one above the other. In practice, stopes are kept in steps, with the north stope leading to correspond with the mining out of the drift section and sill pillar, which is started on the level above prior to the mining out of the stopes advancing from the level below.

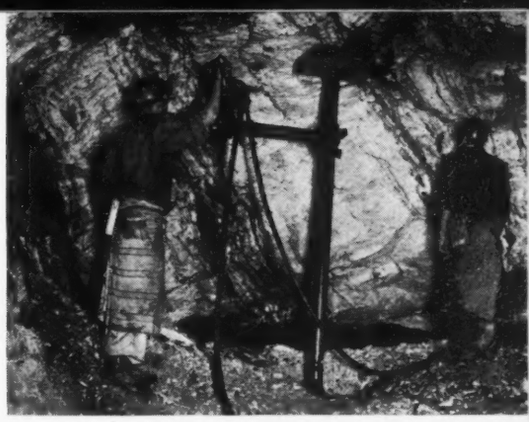
Because of weak walls, stope filling must follow directly behind the cut, with backfill being placed to within 2 ft. of the stope back. To meet this condition and allow continuous operation of individual blocks, all stopes are designed to have three combined chutes and manways and two fill raises, both chutes and fill raises being spaced equidistant within the stope block so as to minimize the manual spread of fill and the amount of wheelbarrow work required in moving broken ore to chutes.

As soon as a stope has been laid out, chute and manway raises are driven from the back of the level to that of the sill cut, leaving a 9-ft. pillar over the drift. Chutes are connected by sublevel which extends to the north and south stope boundaries. The sublevel is slashed to the vein walls to form the first stope cut at the same time that fill-hole raises are being driven in the vein to the level above.

The floor of the sill cut and the stope boundaries are lined with 4-in. round poles or scrap mine timber. No difficulty has been observed in coming up under this lagging in mining out the sill pillar or removing the ore against the vertical lagging from the adjacent stope.

Chute and manway are cribbed separately with 6-in. round timber. Cribbing is advanced at an angle equal to the average dip of the vein between levels as the slope is filled. The chute compartment has four 45-lb. rail grizzlys with 10-in. spacing.

Stoping is done by L-74 drifters



Drilling stope face in narrow section of vein

mounted on a 3½-in. column with a universal arm either 5 or 6 ft. long, which permits a wide section of the stope face to be drilled each shift in one set-up. Holes are drilled horizontal 6 to 8 ft. deep and loaded with one to three sticks of Gelex No. 2 (40 percent) dynamite. The 2-ft. air gap between the fill and the back of the previous cut allows for a certain amount of gravity overbreak on each blast. S-49 jackhammers are used in stopes to drill large boulders that cannot be broken by hand.

Stope support is normally maintained during the cut by "umbrella" stulls, consisting of a foot block, post and cap of 9-in. round timber, lagged with 4- or 6-in. round timber blocked to the back. The area supported by these stulls is approximately 12 sq.ft., and the stull will carry considerable weight before starting to fail. On the following cut everything but the foot block is salvaged from the fill by means of a special pole-pulling jack. Umbrella stulls are placed under all doubtful areas in the back, and even in apparently solid ground, stulls are staggered throughout the stope to insure safety.

In opening up new cuts in wide veins it has been our experience that better ground conditions can be maintained by opening the cut on the hanging wall of the vein and breaking this side higher than the footwall side which preforms a stope arch roughly normal to the dip.

Waste fill for most of the stopes is taken from a surface glory hole in the footwall of the 2,000 level portal. Drifts were driven under this area and raises connected to surface to form cones in the detritus and decomposed footwall schist. As the fill pit increased in size, drifts were extended in solid ground and a 20-hp. double-drum electric hoist was installed to scrape fill to the chutes.

The fill is trammed on the 2,000 level to the fill-raise system by a 1.5-ton Mancha storage-battery locomotive, which handles about 220 tons of fill in two 8-hour shifts. The 5,288 fill system extends from the 2,000 level to the 1,830 level, where it is retrammed to the 5,100 fill raise, which extends to the 1,760 level and which will eventually be continued to the 1,660 level.

On each level the fill raise system has a draw chute and bypass, which allows flexibility in distributing fill to stopes on the South and C orebodies.

On the levels above the 2,000, stope filling has been obtained from crosscuts driven to a strong fault plane in the hanging wall that is well removed from stoping. Here chutes are installed and a cave is started on the fault plane. Once the ground begins to cave, there is no difficulty in obtaining waste fill.

Waste fill for the small orebodies near the surface is obtained by breaking waste rock from fill chambers opened in either the hanging or footwall side of the vein, depending upon local conditions. Practically all development waste rock broken in the mine is used for stope filling.

Ore is hand-trammed from all chutes to the nearest pass in 22-cu.ft. side-dump cars. Ore produced on levels above the mill haulage level is bypassed to this level, where it is retrammed to the mill, about 2,000 ft., by a 3-ton trolley locomotive handling 15 1-ton side-dump cars per trip, or approximately 220 per 8-hour shift. Ore produced below the 1,860 level is bypassed to pockets and hoisted to other pockets on the 1,860 level through the internal inclined shaft or by the surface incline hoist. A 1.5-ton Mancha locomotive is used on the 1,860 level for gathering.

Ventilation—The temperature differential between upper and lower levels is sufficient to maintain natural ventilation from the surface adits through the drifts and up manways and stope-fill raises. Ventilation in individual stopes is assisted by the standard stope lay-out, which includes two fill raises, one being always empty. Natural ventilation is helped at certain times of the year by a 15-hp. electric blower exhausting 3,000 c.f.m. at the 1,760-level portal. During the driving of the 1,660 level from surface to connect with the internal shaft a duplicate blower unit was used to ventilate the face through 10-in. galvanized pipe.

Drainage—Our method of opening the mine by adits has practically eliminated the drainage problem. Although the upper levels close to surface are wet during the rainy season, the lower levels are always dry.

A ditch on either side is advanced when driving main drifts. Levels opened north and south from the internal shaft discharge from their ditch lines into a 3-in. pipe, which runs down the shaft and delivers to the first level, which runs down grade out to surface.

To handle small amounts of water in sinking winzes we have used a Chicago Pneumatic No. 7 sludge pump. This unit is easily handled and has a low upkeep cost. To handle water in the internal shaft sump a No. 3 Cameron pump is operated part time, discharging into ditch lines which run to surface.

Contract System—Labor has been recruited from the surrounding region, where small mines have been operated since the time of the early Spanish explorers. Because of the altitude workmen are free from fever and other tropical diseases. It has been necessary, however, to train all men in use of mechanical equipment and acquaint them with modern mining and milling methods. The men have been eager and quick to learn.

Practically all underground work and many surface operations are on a contract basis which allows workmen to earn more than their base rate of pay. Each year over-all efficiency has improved with a corresponding increase in the average daily wage earned. Contract prices have been set for all work, on a piecework basis, by linear measurement, or by volume. Prices vary in accord with the nature of the ground or other governing conditions. Contract prices are set by department heads or division foremen and liquidated by the engineering department at the end of the month or when the contract is completed.

Sharpening Drill Steel—The steel shop, at the portal of the main haulage level, is equipped with an Ingersoll Rand No. 40 sharpener, which has an SP-45 punch attached; a Holman hot miller; a shank grinder; a locally built steel-heating furnace; and a lead-bath tempering furnace.

One-inch hollow-hex steel is used. For drifters and jackhammers, we use a standard 4½-in. collared shank. A straight shank is used in the stope-hammers. Working drill-steel stock consists of 3,000 shanked bars and 850 stoper bars. Shanked steel is made up into four-bar runs with 21 in. between changes. Starter bars measure 2.75 ft. and fourth bars 8 ft. Stoper steel is arranged in the same manner, omitting the long fourth bar.

The standard four-point cross bit is used, the cutting angle being 86 deg. and the reaming angle 5 deg. Starter bars have a 1¾-in. bit gage and there is ⅛-in. reduction for each change; thus fourth bars have a gage of 1.375 in.

In routine sharpening, the dull steel is received, inspected, segregated, and blown out. The bit and three inches of the bar are heated in the steel-heating furnace and passed to the sharpener operator, who punches, forms, dollies, and gages the bit at the rate of 150 per hour. The bar is then passed on to the hot-miller operator, who gages, mills, and blows the bit out.

The hot-miller is important in our shop routine. It produces a uniformly sharpened cutting edge and reaming points. The finished bit is free of scale and rough edges. Its use greatly reduces wear and tear on the sharpener. Hot-miller cutting wheels from the factory mill 75,000 bits and are then dressed by hand and retempered. Dressed wheels mill 25,000 bits before redressing. One wheel has been dressed and tempered eight times and is still in service. Cost of hand dressing and tempering with ferrous cyanide is $5 per wheel.

Sharpened bars are allowed to cool completely before tempering, which is done in an oil-fired, lead-bath furnace. This unit consists of a shallow cast-steel pot approximately 1½ in. thick which contains a working charge of 900 lb. of lead. The pot is supported on a cylindrical furnace, ported on one side to receive the low-pressure burner. The flame swirls around the hemispherical bottom, and exhausts through six stacks arranged around the periphery of the flange supporting the pot. A nickle-cast-iron covered thermocouple is immersed in the lead and connected to a Brown direct-reading pyrometer. Suspended vertically, directly over the pot center, there is a shaft equipped with three disks fitted with spring steel clips which grip and support the drill steel bars. This rack rotates at one revolution in 2½ minutes and holds 13 bars. Capacity is 320 bars per hour.

(To be concluded)

Jumbo used in driving 1,660 level. Unique in design and completely successful, this was developed by Hubert Staufen, division mine foreman

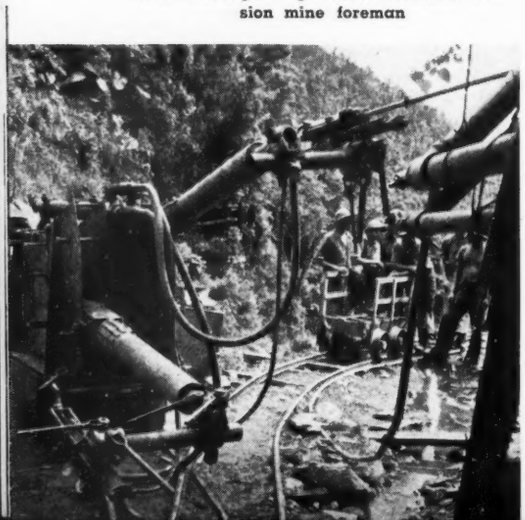


Table III—Operating and Efficiency Data for 1939 and 1940

	1939	1940
Dry tons of ore mined	122,274	131,004
Feet of advance	10,074	12,976
Feet of diamond drilling	1,031	4,131
Total stoping shifts	80,025	72,142
Total development shifts	18,826	25,373
Dry tons of ore mined per miner shift	1.236	1.344
Dry tons of ore mined per stope shift only	1.528	1.817
Feet of advance per development shift	0.523	0.516
Dry tons of ore mined per foot of development	12.420	10.350
Pounds of powder per ton of ore mined	0.329	0.402
Pounds of powder per foot of advance	7.270	7.240
Board feet of timber used per ton of ore mined	17.040	18.790

CURRENT METAL

Statistics

THE AUTHORITIES in Washington have been busy on the problem of establishing quotas for producers of copper, lead, and zinc on which to base premium payments on extra production for the next two and one-half years. Though a number of producers have received notification of their status under the premium regulations, the month of March ended with most operators still in the dark as to where they stand.

Statistics issued so far this year for the three major non-ferrous metals revealed little more than a modest upward trend in output. However, a certain lag occurs in translating new operating conditions into actual results. The extra-quota regulations, it is argued, were not issued until February, and statistics for the first two months of the year should not be taken too seriously in analyzing operations under the new set-up.

Restrictions on imports of zinc, lead, and copper ores and concentrates have been removed from Imports Order M-63. This action was taken because imports can be controlled by other means and their inclusion in the order caused unnecessary duplication of effort. Cadmium also was freed from the import regulations for the same reason.

▶ COPPER—Though output of refined copper in the United States during February was lower than that of the preceding month, calculated on a tonnage basis, the daily rate of production was higher. The daily rate of February (28 days) was 2,918 tons, against 2,904 tons in January.

A summary of the January and February statistics of Copper Institute, in tons, follows:

	Jan..	Feb.
Production:		
Crude (a)	(b)88,205	80,303
Refined	90,017	81,724
Deliveries, refined (c):		
Domestic	130,467	107,616
Export	.....	.....
Stocks, refined end of month (d)	81,371	77,329

(a) Mine or smelter production or shipments, and custom intake, including scrap. (b) Corrected. (c) Beginning March, 1941, includes deliveries of duty-paid foreign copper for domestic consumption. (d) At refineries, on consignment, and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

▶ QUICKSILVER—Domestic production of quicksilver during January amounted to 3,700 flasks, which compares with 3,900 flasks in December and a monthly average for all of 1941 of 3,666 flasks, according to the Bureau of Mines. Consumption of quicksilver in this country for January was estimated at 3,800 flasks, against 3,900 flasks in December.

▶ ZINC—Production of slab zinc in this country, together with imports, should develop a total supply of 1,000,000 tons in 1942 and 1,074,000 tons in 1943, according to an estimate by the American Zinc Institute.

Production of slab zinc in the United States in recent years, according to the Bureau of Mines, in tons, was as follows:

	Tons
1938	478,000
1939	557,700
1940	724,000
1941	881,000

Imports of slab zinc during 1941 brought the total supply available for both domestic consumption and export to well over 900,000 tons.

An analysis of production for 1941 reveals that 43 percent of the output consisted of High Grade zinc. Estimates for 1942 point to an expansion in production for all grades, with the percentage of High Grade moving up to 44.5 percent of the total output. The production program has been planned for flexibility in output. In case of need, a substantial tonnage of the lower grades of zinc can be converted into High Grade.

The Institute contends that it is reasonable to expect that sufficient zinc will continue to be available for all uses that are essential, both directly and indirectly, to the war effort.

Estimated zinc consumption in the United States for 1941, based on information released by the Bureau of Mines, along with estimated exports, in tons, follows:

Zinc in:	Tons
Galvanizing	317,000
Brass making	234,000
Die casting	123,000
Sheet and strip	79,000
Zinc oxide	15,000
Miscellaneous	9,000
Total	777,000
Export slab zinc	80,000
Total	857,000

▶ FLUORSPAR—Shipments of fluorspar from mines in this country amounted to 320,669 tons during 1941, which compares with 233,600 tons in 1940, according to figures compiled by the Bureau of Mines. The tonnage for last year was 22 percent greater than in the previous record year, 1918. The industry was called upon to supply an unprecedented demand in 1941 to meet the requirements of steel mills and aluminum plants. Activity in other consuming industries also was up sharply.

Import statistics covering all of 1941 are not available owing to war restrictions, but during the first nine months of the year a total of 7,311 tons of fluorspar arrived in this country from foreign sources, chiefly Mexico and Spain. Total imports for 1940 amounted to 11,873 tons.

▶ ASBESTOS—Based on sales of asbestos, production in the United States during 1941 was the highest in the history of the domestic industry. According to the Bureau of Mines, the quantity sold or used by domestic producers totaled 24,391 tons in 1941, exceeding the performance of the previous year by 22 percent. During recent years the domestic production has supplied from 4 to 8 percent of national requirements.

▶ MANGANESE ORE—Domestic production of manganese ore containing 35 percent or more manganese (natural) during January, 1942, was 11,700 long tons; shipments were 11,700 tons; and producers' stocks at the end of the month were 1,400 tons according to the Bureau of Mines. In December, 1941, production was 10,100 long tons; shipments were 9,700 tons; and producers' stocks at the end of the month were 1,400 tons.

Shipments in 1941 totaled 76,000 long tons, or an average of about 6,300 tons per month. The rate of shipments averaged 3,344 tons monthly in 1940, when the total amounted to 40,123 tons.

▶ LEAD—Output of lead refined in the United States during February amounted to 50,230 tons, which compares with 53,385 tons in January, according to the American Bureau of Metal Statistics. With shipments smaller, stocks at the end of the month increased to 24,830 tons. The figures for January and February, in tons, follow:

	Jan.	Feb.
Stock at beginning	20,185	20,531
Production:		
From domestic ore	43,307	45,633
Secondary and foreign	10,078	4,597
Totals	53,385	50,230
Domestic shipments	53,037	45,920
Stock at end	20,531	24,830

The following tabulation shows total lead stocks at United States smelters and refineries, in tons, according to the American Bureau of Metal Statistics.

	Feb. 1	Mar. 1
In ore, matte, process (a)	58,867	56,937
In base bullion:		
Smelters and refineries	8,005	6,906
In transit to refineries	3,028	4,872
In process at refineries	16,428	15,332
Refined lead	16,578	20,774
Antimonial lead	3,953	4,056
Total stocks	106,856	108,877

Receipts of lead in ore and scrap by smelters in the United States, computed on basis of recoverable lead, in tons:

Receipts in ore:	Jan.	Feb.
Domestic	43,224	41,828
Foreign	11,229	4,740
Totals	54,453	46,568
Receipts in scrap (a)	1,903	1,856
Totals	56,356	48,424

(a) Inclusive only of scrap smelted in connection with ore, plus some scrap received by primary refiners.

▶ COPPER—Sales of domestic copper for delivery in the United States or its possessions for the last seven years, in tons:

	Tons
1935	580,018
1936	966,358
1937	517,674
1938	512,760
1939	804,241
1940	1,109,750
1941	1,006,831

Summary of the

MARKETS

ORDERS ISSUED by the War Production Board during the last month reveal that scarce non-ferrous metals are to be allocated in the future with strict regard for the actual fabricating requirements of the war program, including the Army and the Navy. Forward buying will be curbed. This plan of rationing supplies has been in operation on various strategic materials, including aluminum, nickel, and copper. The zinc pool was increased on High Grade to the extent of 10 percent and the General Preference Order M-11, under which an emergency supply has been set aside monthly since April, 1941, has been extended to May 31, 1942, pending completion of a revised zinc order.

The only price change of importance that occurred during March was an upward revision in antimony. Producers in this country were permitted by OPA to lift the quotation 1½c. a pound on March 23, establishing the price on the standard grade, in bulk, at 14½c., carload lots, f.o.b. Laredo, Texas. On lots of 5 tons or more but less than a carload the New York quotation was raised to the equivalent of 15.955c. a pound, for metal packed in cases, ex store. The higher selling basis was approved by authorities in Washington after a careful study of all cost factors. At the higher price, production of antimony ore outside of the United States should increase, experts contend.

In clarifying the quicksilver schedule, OPA ruled that fixing of maximum prices f.o.b. point of shipment does not require a dealer to pay charges for the initial transportation of the metal from a mine to a common carrier.

Complete allocation of molybdenum ore and concentrate has been ordered, effective May 1. Under the regulations, contained in General Preference Order M-110, requests for delivery of molybdenum must be received by the War Production Board by the 20th of the preceding month.

Demand for copper continued at a high rate. Consumption during February, in view of the short month, compared favorably with that of January. Exports of bar copper from Chile during January totaled 37,163 tons, of which 35.858 tons was consigned to the United States. The price situation in copper was unchanged, domestic metal holding at 12c., Valley, with foreign copper bringing 11.75c., f.a.s. basis, United States ports.

UNITED STATES MARKET

1942 Mar.	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
2	11.775	11.700	52.000	6.50	6.35	8.25
3	11.775	11.700	52.000	6.50	6.35	8.25
4	11.775	11.700	52.000	6.50	6.35	8.25
5	11.775	11.700	52.000	6.50	6.35	8.25
6	11.775	11.700	52.000	6.50	6.35	8.25
7	11.775	11.700	52.000	6.50	6.35	8.25
9	11.775	11.700	52.000	6.50	6.35	8.25
10	11.775	11.700	52.000	6.50	6.35	8.25
11	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
13	11.775	11.700	52.000	6.50	6.35	8.25
14	11.775	11.700	52.000	6.50	6.35	8.25
16	11.775	11.700	52.000	6.50	6.35	8.25
17	11.775	11.700	52.000	6.50	6.35	8.25
18	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
20	11.775	11.700	52.000	6.50	6.35	8.25
21	11.775	11.700	52.000	6.50	6.35	8.25
23	11.775	11.700	52.000	6.50	6.35	8.25
24	11.775	11.700	52.000	6.50	6.35	8.25
25	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25
27	11.775	11.700	52.000	6.50	6.35	8.25
28	11.775	11.700	52.000	6.50	6.35	8.25
30	11.775	11.700	52.000	6.50	6.35	8.25
31	11.775	11.700	52.000	6.50	6.35	8.25
	AVERAGES FOR MONTH					
Mar.	11.775	11.700	52.000	6.50	6.35	8.25
Mar.	**AVERAGES FOR WEEK**					
4	11.775	11.700	52.000	6.50	6.35	8.25
11	11.775	11.700	52.000	6.50	6.35	8.25
18	11.775	11.700	52.000	6.50	6.35	8.25
25	11.775	11.700	52.000	6.50	6.35	8.25
Mar.	**CALENDAR WEEK AVERAGES**					
7	11.775	11.700	52.000	6.50	6.35	8.25
14	11.775	11.700	52.000	6.50	6.35	8.25
21	11.775	11.700	52.000	6.50	6.35	8.25
28	11.775	11.700	52.000	6.50	6.35	8.25

SILVER, GOLD AND STERLING EXCHANGE

1942 Mar.	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver (c): New York	Silver: London	Gold: London	Gold (d): United States
2	401.000	(f)	35.125	23.500	168s.	$35.00
3	401.000	(f)	35.125	23.500	168s.	35.00
4	401.000	(f)	35.125	23.500	168s.	35.00
5	401.000	(f)	35.125	23.500	168s.	35.00
6	401.000	(f)	35.125	23.500	168s.	35.00
7	401.000	(f)	(e)	(e)	(e)	35.00
9	401.000	(f)	35.125	23.500	168s.	35.00
10	401.000	(f)	35.125	23.500	168s.	35.00
11	401.000	(f)	35.125	23.500	168s.	35.00
12	401.000	(f)	35.125	23.500	168s.	35.00
13	401.000	(f)	35.125	23.500	168s.	35.00
14	401.000	(f)	(e)	(e)	(e)	35.00
16	401.000	(f)	35.125	23.500	168s.	35.00
17	401.000	(f)	35.125	23.500	168s.	35.00
18	401.000	(f)	35.125	23.500	168s.	35.00
19	401.000	(f)	35.125	23.500	168s	35.00
20	401.000	(f)	35.125	23.500	168s.	35.00
21	401.000	(f)	(e)	(e)	(e)	35.00
23	401.000	(f)	35.125	23.500	168s.	35.00
24	401.000	(f)	35.125	23.500	168s.	35.00
25	401.000	(f)	35.125	23.500	168s.	35.00
26	401.000	(f)	35.125	23.500	168s.	35.00
27	401.000	(f)	35.125	23.500	168s.	35.00
28	401.000	(f)	(e)	(e)	(e)	35.00
30	401.000	(f)	35.125	23.500	168s.	35.00
31	401.000	(f)	35.125	23.500	168s.	35.00
	AVERAGES FOR MONTH					
Mar.	401.000	.....	35.125	23.500	....	35.00
Mar.	**AVERAGES FOR WEEK**					
4	401.000	.....	35.125	.....	....	.....
11	401.000	.....	35.125	.....	....	.....
18	401.000	.....	35.125	.....	....	.....
25	401.000	.....	35.125	.....	....	.....

Calendar week averages, New York Silver: March 7th, 35.125; 14th, 35.125; 21st, 35.125; 28th, 35.125.

(e) Not quoted (Saturday). (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the World War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. We deduct .05c. from the f.a.s. basis (lighterage, etc.) to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c. throughout March.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

The present supply of lead is larger than many in the industry had hoped for, which is due to continued fairly large imports of the metal. However, the outlook has been obscured somewhat because of uncertain developments in two producing centers—Australia and Burma. Pool needs for April continued at 15 percent of production.

The zinc industry was prepared for full allocation after March 31, but the old plan was extended for two months. The emergency pool in zinc for April calls for 60 percent of production in the High Grade division, an increase of 10 percent, with the other grades unchanged at 40 percent.

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LONDON TIN—Trading in Standard tin in London remained suspended throughout March.

OFFICIAL LONDON PRICES—COPPER, LEAD, ZINC

Following are the maximum prices of copper, lead, and zinc established by the Ministry of Supply for the British market, in effect since Dec. 18, 1939:

	Per £	Long s.	Ton d.
COPPER:			
Electrolytic, high conductivity	62	0	0
Fire refined, high conductivity	62	0	0
Fire refined, high grade	61	10	0
Fire refined, min. 99.7 percent	61	0	0
Fire refined, min. 99.2 percent	60	10	0
Hot rolled black wire rods	65	10	0
LEAD:			
Soft foreign, duty paid	25	0	0
Soft, Empire	25	0	0
English refined	26	10	0
ZINC:			
Foreign (G.o.b.), duty paid	25	15	0
Domestic (G.o.b.)	26	10	0
Prime Western and debased	26	10	0
Refined and electrolytic	27	5	0
Minimum 99.99 percent	28	15	0

Quotations are for metal delivered to the consumer.

E & M J PRICE INDEX

Weighted index of non-ferrous metal prices. The average for the years 1922-1923-1924 equals 100.

1929	110.33	1935	74.66
1930	82.87	1936	73.45
1931	60.20	1937	90.86
1932	48.26	1938	73.67
1933	59.79	1939	77.71
1934	69.59	1940	79.22
1941	83.49		

	1940	1941	1942
January	80.85	82.48	85.39
February	77.23	82.76	85.90
March	77.94	83.27	85.90
April	77.19	83.48	....
May	77.68	83.51	....
June	78.85	83.48	....
July	76.72	83.60	....
August	76.71	83.39	....
September	79.40	83.34	....
October	82.49	83.84	....
November	83.14	84.32	....
December	82.42	84.42	....

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(April 1, 1942)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb ..... 15c.
Antimony, domestic, spot, lb 5 ton or more ..... 15.955c.
Bismuth, ton lots, lb $1.25
Cadmium, commercial sticks, lb ..... 90c.
Calcium, lb., ton lots 97 @ 98 per cent $1.25
Chromium, 97 per cent grade, lb ..... 89c.
Cobalt, 97 to 99 per cent, per lb $1.50
Nickel, electrolytic cathodes, lb ..... 35c.
Magnesium, 99.8 per cent, carloads, lb ..... 22½c.
Palladium, troy oz $24.00
Platinum, (Official quotation) troy oz $36.00
Quicksilver, flask of 76 lb., 100 flasks or more $197.05
Radium, mg. radium content ..... $25.00@$30.00
Selenium, 99.5 per cent, lb $1.75
Silicon, minimum 97 per cent, spot, carloads lb ..... 14.75c.
Tellurium, lb $1.75
Thallium, 100 lb. or more, lb $10.00
Titanium, 96 to 98 per cent, lb $5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton ..... $30.00@$35.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry, 48% Cr_2O_3, 2.8 to 1 ratio $39.00
Domestic, 48%, 2.5 to 1 ratio (f.o.b. mines) $40.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:
Old Range bessemer $4.75
Mesabi bessemer $4.60
Old Range non-bessemer $4.60
Mesabi, non-bessemer $4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton $76.54
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:
50 per cent ..... 66c.
48 per cent ..... 65c.
46 per cent ..... 64c.
Manganese Ore, domestic, 48%, f.o.b. mines, l.t. unit ..... 75c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines ..... 45c.
Tungsten Ore, per unit of WO_3:
Chinese, 65 per cent, duty paid ..... (b) $24.00
Domestic, 65 per cent and upward ..... (a) $26.00
Vanadium Ore, per lb. of contained V_2O_5 ..... 27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton $55.28
(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb ..... 4c.
Cobalt Oxide, 70 @ 71 per cent, lb $1.84
Copper Sulphate, 100 lb $5.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb $1.43
Sodium Sulphate, bulk, ton ..... $18.00@$24.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be $15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained ..... 13c.
Ferromanganese, 78 @ 82 per cent, gross ton $120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained ..... 95c.
Ferrosilicon, 50 percent, gross ton $74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained $1.90
Ferrovanadium, per lb. of V, delivered ..... $2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U.S. funds), ton;
Crude No. 1 ..... $650@$750
Crude No. 2 ..... $165@$385
Spinning fibers ..... $124@$233
Paper stock ..... $44@$49.50
Shorts ..... $14.50@$26.50
Vermont, f.o.b. Hyde Park:
Shingle stock ..... $62.50@$65.50
Paper stock ..... $44.00@$53.00
Shorts ..... $14.50@$28.50
Floats $19.50
Barytes, long ton:
Georgia, crude $9.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron $7.00
Bauxite, long ton:
Domestic, crude, 50 @ 52 percent (not dried) $5.00
Domestic, chemical, 55 @ 58 per cent ..... $7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent $16.00
China Clay, f.o.b. mines, ton:
South Carolina and Georgia, No. 1, bulk ..... $6.75@$8.00
Delaware, No. 1 ..... $14.50
Feldspar, bulk, ton:
Potash feldspar, 200 mesh $17.00
Glass-spar, white, 20 mesh $11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton $25.00
Ground, 95 @ 98 percent, bulk, ton $34.00
Lump, acid, 98 percent, bulk, ton $35.00
Fuller's earth, f.o.b. Georgia or Florida, ton ..... $7.00@$14.00
Magnesite, per ton:
Dead-burned, f.o.b. Washington $22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:
1½ x 2 in ..... 45@65c.
2 x 2 in ..... 60@85c.
3 x 3 in ..... $1.85@$2.05
3 x 4 in ..... $2.15@$2.25
3 x 5 in ..... $2.50@$2.75
White, ground, 70 mesh, ton ..... $80.00@$80.00
Ocher, Georgia, ton ..... $19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports ..... (a) 12c
Silica, in bags, 325 mesh, ton ..... $20.00@$40.00
Sulphur, Texas, mines, long ton $16.00
Talc, f.o.b. works, ton:
New York, double air-floated, 325 mesh ..... $12.00@$15.00
New Jersey, mineral pulp ..... $8.50@$10.50
Vermont, extra white, 200 mesh ..... $9.50@$10.00
Tripoli, Missouri, ton:
40 mesh, cream colored $14.50
200 mesh, cream colored $26.00
(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic $23.50
Steel, base prices, Pittsburgh:
Billets, gross ton $34.00
Structural shapes, 100 lb $2.10
Bars, 100 lb $2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1941	1942	1941	1942	1941	1942
January	34.750	35.125	23.273	23.500	(a) 402.000	(a) 401.000
February	34.750	35.125	23.341	23.500	(a) 401.864	(a) 401.000
March	34.750	35.125	23.446	23.500	(a) 401.788	(a) 401.000
April	34.750	.....	23.500	.....	(a) 401.058	.....
May	34.750	.....	23.457	.....	(a) 400.981	.....
June	34.750	.....	23.400	.....	(a) 401.000	.....
July	34.750	.....	23.397	.....	(a) 401.000	.....
August	34.750	.....	23.459	.....	(a) 401.000	.....
September	34.750	.....	23.500	.....	(a) 401.000	.....
October	34.750	.....	23.500	.....	(a) 401.000	.....
November	34.772	.....	23.500	.....	(a) 401.000	.....
December	35.125	.....	23.500	.....	(a) 401.000	.....
Year	34.783	.....	23.439	.....	(a) 401.224	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

COPPER

	F.O.B Refinery, Electrolytic			
	Domestic		Export	
	1941	1942	1941	1942
January	11.819	11.775	10.257	11.508
February	11.794	11.775	10.414	11.700
March	11.814	11.775	10.592	11.700
April	11.820	.....	10.952	.....
May	11.815	.....	10.950	.....
June	11.810	.....	10.950	.....
July	11.812	.....	10.950	.....
August	11.778	.....	10.950	.....
September	11.775	.....	11.027	.....
October	11.775	.....	11.367	.....
November	11.775	.....	11.200	.....
December	11.775	.....	11.200	.....
Year	11.797	.....	10.901	.....

New York quotations, cents per pound.

LEAD

	New York		St. Louis	
	1941	1942	1941	1942
January	5.500	6.275	5.350	6.125
February	5.602	6.500	5.452	6.350
March	5.765	6.500	5.613	6.350
April	5.850	.....	5.700	.....
May	5.850	.....	5.700	.....
June	5.850	.....	5.700	.....
July	5.850	.....	5.700	.....
August	5.850	.....	5.700	.....
September	5.850	.....	5.700	.....
October	5.850	.....	5.700	.....
November	5.850	.....	5.700	.....
December	5.850	.....	5.700	.....
Year	5.793	.....	5.643	.....

New York and St. Louis quotations, cents per pound.

TIN

	Straits New York		Standard, Spot London	
	1941	1942	1941	1942
January	50.154	52.000	256.648	(b)
February	51.293	52.000	264.975	(b)
March	52.067	52.000	270.131	(b)
April	51.981	.....	269.775	.....
May	52.166	.....	267.534	.....
June	52.685	.....	262.750	.....
July	53.481	.....	258.272	.....
August	52.385	.....	257.013	.....
September	52.000	.....	256.364	.....
October	52.000	.....	255.842	.....
November	52.000	.....	256.713	.....
December	52.000	.....	(a) 257.625	.....
Year	52.018	.....	261.137	.....

New York quotations, cents per pound. London, pounds sterling per long ton. Average of 6 days. Quotations suspended Dec. 9. (b) Not quoted.

ZINC

	St. Louis			
	1939	1940	1941	1942
January	4.500	5.644	7.250	8.250
February	4.500	5.534	7.250	8.250
March	4.500	5.750	7.250	8.250
April	4.500	5.750	7.250	.....
May	4.500	5.803	7.250	.....
June	4.500	6.235	7.250	.....
July	4.516	6.250	7.250	.....
August	4.719	6.389	7.250	.....
September	6.104	6.920	7.250	.....
October	6.500	7.250	7.942	.....
November	6.500	7.250	8.250	.....
December	5.980	7.250	8.250	.....
Year	5.110	6.335	7.474	.....

St. Louis quotations, Prime Western, cents per pound.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1941 (a)	1942 (a)	1941	1942
January	80.000	90.000	17.000	15.000
February	82.273	90.000	17.000	15.000
March	89.038	90.000	17.000	15.000
April	90.000	.....	17.000	.....
May	90.000	.....	17.000	.....
June	90.000	.....	17.000	.....
July	90.000	.....	17.000	.....
August	90.000	.....	17.000	.....
September	90.000	.....	17.000	.....
October	90.000	.....	15.000	.....
November	90.000	.....	15.000	.....
December	90.000	.....	15.000	.....
Year	88.443	.....	16.500	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1941	1942	1941	1942	1941	1942
January	14.000	14.000	165.846	202.519	36.000	36.000
February	14.000	14.000	170.182	197.272	36.000	36.000
March	14.000	14.602	177.692	197.050	36.000	36.000
April	14.000	.....	180.077	.....	36.000	.....
May	14.000	.....	180.000	.....	36.000	.....
June	14.000	.....	183.920	.....	36.000	.....
July	14.000	.....	188.577	.....	36.000	.....
August	14.000	.....	192.000	.....	36.000	.....
September	14.000	.....	192.440	.....	36.000	.....
October	14.000	.....	193.615	.....	36.000	.....
November	14.000	.....	196.273	.....	36.000	.....
December	14.000	.....	199.654	.....	36.000	.....
Year	14.000	.....	185.023	.....	36.000	.....

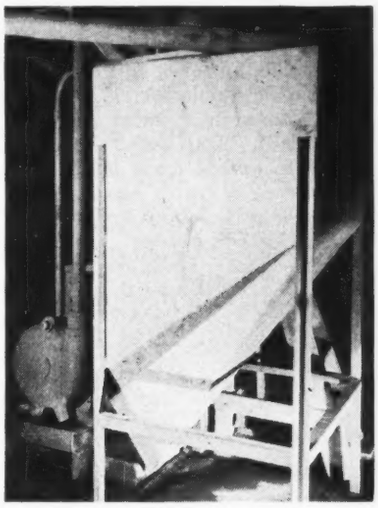
(a) Antimony, cents per pound, ordinary brands, in cases; in bulk f.o.b. Laredo, Tex., 13.462 for March. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1941	1942	1941	1942	1941	1942
January	24.50	24.50	23.50	23.50	24.00	24.00
February	24.50	24.50	23.50	23.50	24.00	24.00
March	24.50	24.50	23.50	23.50	24.00	24.00
April	24.50	.....	23.50	.....	24.00	.....
May	24.50	.....	23.50	.....	24.00	.....
June	24.50	.....	23.50	.....	24.00	.....
July	24.50	.....	23.50	.....	24.00	.....
August	24.50	.....	23.50	.....	24.00	.....
September	24.50	.....	23.50	.....	24.00	.....
October	24.50	.....	23.50	.....	24.00	.....
November	24.50	.....	23.50	.....	24.00	.....
December	24.50	.....	23.50	.....	24.00	.....
Year	24.50	.....	23.50	.....	24.00	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

USEFUL OPERATING IDEAS



Steep slopes of sides and back cause the solids to slide uniformly to pump suction

Stopping Pump Feed Troubles

CHANGING the bottom design of boxes feeding the Wilfley centrifugal sand pumps in the mill of the Mahoning Mining Co., Rosiclare, Ill., eliminated the clogging of the pump suction experienced when the mill was started in 1939. The boxes were changed from flat bottoms to hopper shape with both back and side plates sloping at 60 deg. to the horizontal to converge at the side where the pump suction is connected. Previous to making this change, when the bottom was flat, the solids would tend to pile up to a considerable height, and then slide down in such quantity as to seal the pump suction. On the 60-deg. slopes the material slides uniformly to the suction. Eleven pumps and boxes, such as shown in the illustration, handle the ore feed, concentrates, and middlings in this flotation plant, which recovers fluorspar, zinc sulphide, and lead sulphide from ore which the company mines near Cave-in Rock, 18 miles away.

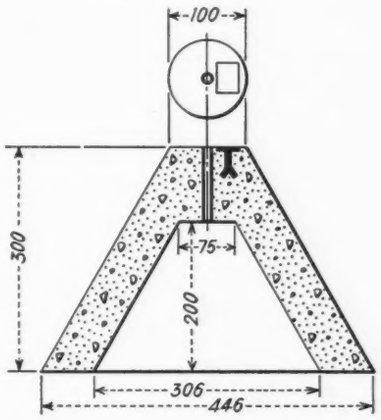
▼

Survey Station

IN SURVEYING alluvial deposits in the Belgian Congo we came to a real problem in choosing the type of permanent station we could use, writes R. W. Michael, of New York. Wooden pegs rapidly disappeared under the ravages of termites. Suitable rocks were seldom available at the site. Neighboring tribesmen were always hungry for iron from which to make knives and spear points. An iron peg would disappear like magic. It had to be something that always looked the same to the native rodman, so that he could be sure he was on the right spot.

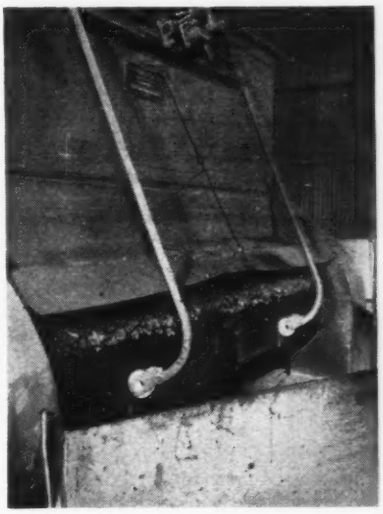
The solution was a pre-cast concrete station, a hollow casting in the form of the frustrum of a cone, shown in the sketch. It has the following dimensions: Top diameter, 100 mm., or 4 in.; bottom diameter, 446 mm., or 17.5 in.; height, 300 mm., or 11.8 in.; wall thickness, 60 mm. or 2.37 in.; head thickness, 100 mm., or 4 in.; weight, 32 kg., or 70.5 lb.; cement required, 4.3 kg., or 9.54 lb. One barrel of cement will make 40 stations.

In the center of the head of the casting there is a 4-in. length of $\frac{1}{4}$-in. pipe, and the top surface of the casting also carried a flat iron plate in which the station number had been stamped. The round hole, which actually is about $\frac{3}{8}$ in. in diameter, makes it easy for the native rodman to center the conical tip of a range pole.



The station is set flush with the ground, and if the exploitation is set for a long time in the future, it is covered entirely with a light layer of earth. On the pit line on either side of the station small witness trenches are dug. Any time it is necessary to occupy the station, it can easily be found by dragging a shovel between the ends of the two trenches.

A portable steel form was constructed for making two stations at a time. The core carried a steel rod over which the pipe section was slipped. The number plate was dropped in face down, and the casting was made. There was plenty of time for making the stations while the lines of sight were being cleared. Also a nice lot of classified aggregate was always at hand where the prospector washed his pit samples. The salvage value of the stations was 100 percent.



Fluorspar pellets stick to the screen but are jarred loose when screen section rotates

Vibrator Frees Screen

AN ELECTRIC VIBRATOR installed in an unusual manner solved a problem in freeing fluorspar pellets from the screen sections of a Proctor & Schwartz heat dryer in the mill of the Mahoning Mining Co., Rosiclare, Ill. When the plant was started in 1939 a man had to be stationed at the dryer discharge to jar the pellets loose. Next, a rake attachment was tried, but it caused some degradation of the pellets and some screen wear.

A Syntron vibrator was suggested, but how to apply it to the screen sections of the moving apron conveyor was a puzzle. Finally the arrangement shown in the illustration was adopted. It operates with complete satisfaction and without pellet degradation nor appreciable screen wear.

The frame supporting the V-25 vibrator is pivoted at the top so that the bottom ends of 5-ft. arms press lightly by gravity against the screens. The rollers are ball bearings with the outer race riding on the screen. Because of the heat from the dryer these ball bearings are operated without lubrication, yet the life is long because of the slow operation.

▼

Shaft Plumbing

A METHOD of transferring bearings from the surface to the underground workings independently of plumb lines is described by E. J. Horwood in the *Proceedings* (No. 118) of the Australasian Institute

of Mining and Metallurgy, as having been used by him many years ago.

An attachment was procured for the theodolite, consisting of a 45-deg. prism enabling a view of a fine line stretched across the shaft at the surface to be observed from the shaft bottom. The instrument was so set up that a view of the portion of the surface line could be obtained as close as possible to the shaft timbers.

By candle-light signals an assistant at the surface moved his line so that the portion close to the side or end of the shaft coincided with the crosswires of the theodolite. The instrument was then swung to enable the crosswires to traverse the surface line. It was a simple matter to transfer the bearing of the surface line to points in the drift extending from the shaft. Similarly, the relation of the bearing of the surface line to the shaft, with which a connection was intended, was easily obtained. Success of this method was demonstrated at Broken Hill in making connections hundreds of feet from the shafts from which these were driven.

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Mine Track Turnouts

Fig. 1—Curved

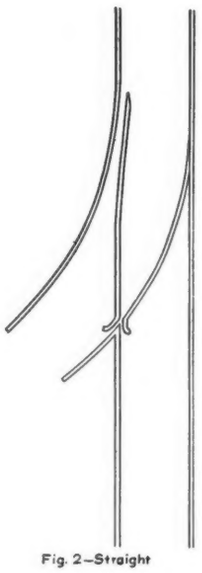

Fig. 2—Straight

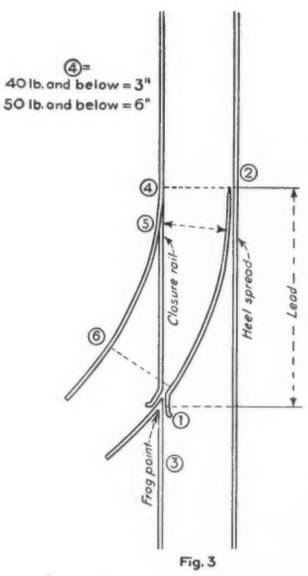

Fig. 3

WHEN track haulage systems are planned for new mine developments the choice lies between the straight frog and switch turnouts and the curved turnouts according to P. C. Ziemke, Milwaukee, Wis. These two may be easily identified. If the gage line of the turnout follows a true curve (Fig. 1) it is termed a curved turnout. On the other hand, if the frog and switch are both straight and joined by a curved rail, to which frog and rail are tangent, it is known as a straight frog and switch turnout (Fig. 2).

The straight layout is by far the most popular, on account of its simplicity and adaptability to either right- or left-hand turns, low price, and availability from most mine supply house stocks. Also it is better adapted to the operation of long-wheelbase rolling stock.

The advantage in the curved turnout lies in the fact that the unit is simple to install as compared with the straight type, as the frog joins directly to the switch and requires only that the frog be spiked in place and the switch joined directly to it. It makes for good, speedy operation, as the curved section is true and smooth, though its disadvantage is that it must be especially made, as it is not applicable to both right- or left-hand layouts. Also, jobbers usually do not stock this model, and this fact adds to its price. Long-wheelbase rolling stock often experiences difficulty in making such a turn, as there is a tendency for wheel flanges to catch in the tip of the frog point.

The installation of a turnout seems a formidable undertaking at first glance, but like many other jobs it is soon mastered. With material at hand, such as ties, spikes, track bolts, angle bars, guard rails, switch plates, curved and straight rail sections, switch bars, two switch points, a switch stand, and a frog, the job is ready for installation. First the frog must be located with reference to the crosscut or entry, referred to as point 1 (Fig. 3). Next, the distance from point of frog to point of switch point, or "lead," is measured. This value is reached by adding switch length, straight closure rail length, and toe length of the frog. There is a possibility here that the joint at some point in the straight Track 2 interferes with the heel, or switch point, in which case a new section of rail is substituted to shift the location of the joint. Remove regular length ties and replace them with long switch ties in proper position to support the frog and switch point, while the remaining space is equally divided and filled with the remaining ties.

Next, the old track at point 3. In rare instances a joint may be conveniently near, and in such cases the bars are removed and cutting is avoided. The rail is then bent at point 4, thereby giving point 5 the proper heel-spread distance from the gage line. For distance 6 refer to the table. The closure rail, switch point, frog, switch plates, and stand are now placed in their proper positions, followed by bolting the closure rails snugly to the frog. Then the main rail is lightly bolted to the frog and the closure rail is similarly bolted to the switch points.

Tamping the ties is next done so that the various units may be securely spiked down when properly aligned, being sure that the switch point on the turnout line is set with the correct amount of heel-spread from the gage line. Last of all, the joint at the heel of the frog is tightened, and the switch bar is bolted in place to the switch lugs.

In fastening the "Jim Crow" on the main rail between points 5 and 6, it is bent to match the opposite closure rail. Then with gage applied this section is spiked in place. At this point if a guard rail is to be used it should be bent and spiked in alignment with the main rail, first being sure the center of the guard rail is opposite the throat of the frog.

The switch stand is now bolted to the switch bar and points are so adjusted

Table I—Wheel Base and Minimum Radius

Wheel base	24 in.	28 in.	32 in.	36 in.	42 in.	48 in.	52 in.	60 in.
Minimum radius in feet	15 ft.	18 ft.	21 ft.	24 ft.	28 ft.	32 ft.	36 ft.	40 ft.

Table II—Number of Frog and Gage

No. of Frog	Gage 30 in.	36 in.	42 in.	48 in.	56½ in.
1¾	11 ft.	14 ft	17 ft.	20 ft.	25 ft.
2	13 ft.	17 ft.	22 ft.	26 ft.	33 ft.
2½	21 ft.	28 ft.	35 ft.	41 ft.	51 ft.
3	32 ft.	42 ft.	52 ft.	62 ft.	76 ft.
4	60 ft.	78 ft.	96 ft.	114 ft.	140 ft.
5	93 ft.	120 ft.	148 ft.	174 ft.	212 ft.
6	139 ft.	179 ft.	220 ft.	260 ft.	316 ft.

that they are equidistant from the stock rail. Then the stand lever is connected in the upright position and stand is spiked in place. If the job has been correctly done the points will fit neither too tightly nor too loosely. Points should fit snugly against the stock rails with the lever thrown down, and any maladjustment can be easily corrected by shortening or lengthening the throw of the stand. Where a spring connecting rod is used, this throw can be adjusted to give considerable compression to the spring for either alignment of the switch.

The data in the accompanying Table I will be found helpful in determining the proper or minimum radius, based on average wheel diameters of 20 in., with a maximum gage widening of $\frac{3}{4}$ in.

The radius of a curved turnout, closely matching a straight frog and switch turnout, is given in Table II.

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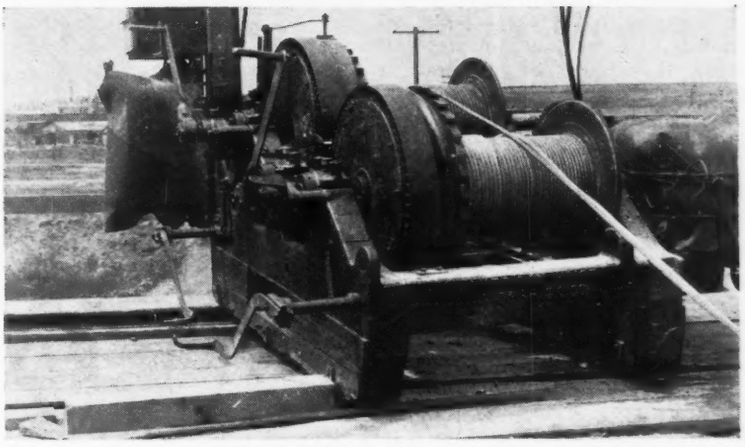
Drying Epsom Salt

DURING THE PAST YEAR Russell N. Thatcher, now with the Johns-Manville Corp., New York, served as engineer at a North Carolina pilot plant producing 1 ton per day of epsom salt, $MgSO_4,7H_2O$, from olivine rock. Inasmuch as expensive centrifuging apparatus was not available, and since the salt with only gravity draining takes many days to dry thoroughly in air; and also because this hydrated salt cannot be dried by heating, the following novel method was devised by Mr. Thatcher for washing the salt free of absorbed mother liquor and drying it by means of a simple, temporary alteration in the molecular structure:

Pans filled with 50 lb. of dripping wet salt right out of the crystallizer tank are set in a hot-water table which uses waste steam condensate from evaporator tubes. After a few minutes, the pans are found to have a deep layer of water and brine on top of the salt. The salt water is decanted, the salt is dumped out and thoroughly mixed; in a few minutes it is almost completely dry (to 3 to 4 percent uncombined H_2O).

What happens is this: the bottom and sides of the pans become hot—their temperature rises above the temperature of the two lower transition points of the epsom-salt solubility curve. As these points are passed by the rising temperature large quantities of molecular water are released from a thick layer of salt around the bottom and sides of the pan. This released molecular water travels upward, washing the remainder of salt in the pan, and forms the water layer on top, which is decanted. When the pan is dumped out and the crust of double-hydrated salt is well mixed with the remainder of unaltered epsom salt (hepta-hydrated), the double hydrated salt at once becomes unstable with temperature drop to room conditions, and this salt immediately begs for water. This water it finds held both on and between individual crystals of the unaltered epsom salt. This process serves to dry to 3 or 4 percent the whole batch of salt. Additional water if required is taken from the atmosphere.

This method is in successful operation and serves both as a purifying wash and as a means of drying a hygroscopic hydrated salt.



Adjustable Hoist Mount

AT TIMES it may be desirable to alter the direction of pull in using a hoist. This may easily be provided for, according to J. C. Coyle, Yuma, Ariz., by mounting the machine on a skid base, with metal skid shoes, resting transversely on suitable metal stringers. The machine is anchored by chain or clevis at the rear so that it can swing easily except when it is held by a wooden chock against the forward corners of the base. The chocks may have projecting metal pins to fit into holes in the platform of wood or concrete. A crowbar is used to move the base.

▼

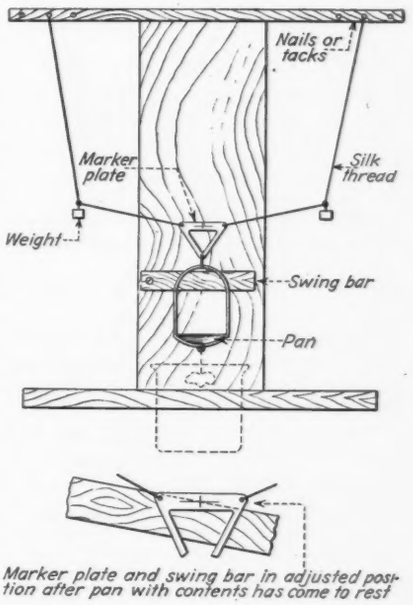
Handy String Balance

THE SIMPLE STRING BALANCE for determining the specific gravity of minerals developed by W. E. Sands, research engineer at the McGill smelter of Nevada Consolidated Copper Corp., McGill, Nev., and explained in detail in the accompanying sketch, has proved surprisingly accurate and handy in field work. It can be carried in a small container, rigged up anywhere, and gives results as accurate as can be obtained with a Jolly balance. Few parts are required besides silk thread to make it, and these include two small weights (small stones or steel nuts will do), a triangular marker plate made from celluloid, a celluloid pan, and a wooden swing bar.

Operation is simple: First, the mineral is placed in the pan, which is then allowed to fall into a position of rest. Next, the pivotal wooden bar is slowly lowered until its upper surface is in line with the cross on the marker plate as indicated. After this has been done, the mineral is removed and, in its place, weights are added to the pan until the cross on the marker plate has

Results Obtained With Balance

Weighing Number	Weight in Grams: String Balance	Weight in Grams: Beam Balance	Error: Grams	Error: %
1	1.000	1.005	0.005	0.50
2	3.700	3.674	0.026	0.71
3	4.720	4.755	0.035	0.74
4	5.000	4.962	0.038	0.76
5	5.000	5.013	0.013	0.26
6	5.000	5.028	0.028	0.56
7	5.000	4.993	0.007	0.14
8	5.000	4.981	0.019	0.38
9	6.700	6.671	0.029	0.43
10	8.010	7.985	0.025	0.31
11	10.000	9.928	0.072	0.72
12	10.000	10.008	0.008	0.08
13	13.750	13.831	0.081	0.59
Total	82.880	82.834	0.046	0.006



Marker plate and swing bar in adjusted position after pan with contents has come to rest

been returned to the exact point set previously. If weighing in water is desired, the piece of mineral is attached to the bottom of the pan by a short length of string and allowed to hang in a glass beaker or other water-filled container. Actual results obtained with the balance described are given in the table on the preceding page.

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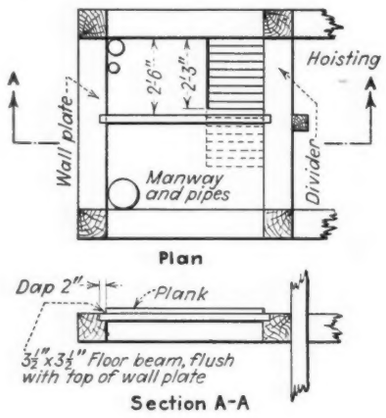
Shaft-Set Planking Support

A METHOD of providing support for planking flush with the top of the set in framing shaft timbers is shown in the accompanying sketch by W. W. Schnarr, of Noranda Mines, Noranda, Quebec, where it has been adopted. A floor beam is dapped into the end plate and the divider to carry the planks. The extra work required of the timber framer is not great, and the advantage is obvious to any shaft man.



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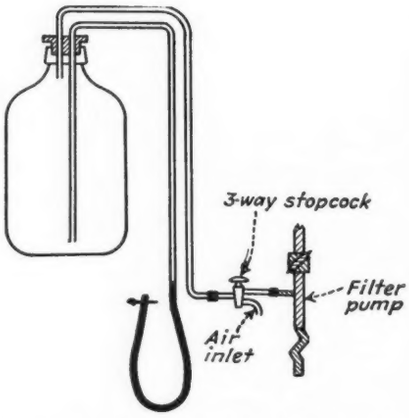
Storage System for Distilled Water

AT THE PLANT of Upper Canada Mines, Ltd., Dobie, Ont., where the assay office provides distilled water for a battery locomotive and miners' electric lamps in addition to its own requirements, the water-storage system shown in the accompanying diagram has given good service, writes J. Nelson, chief assayer. Storage is provided by a carboy holding 10 imperial gallons. Water is drawn off as required by means of the siphon, which is provided with a hose clamp, the three-way stopcock being connected through to the air inlet.

When necessary to add to the water in the carboy, the stopcock is connected through to the filter pump and the fresh charge is drawn up through the same tube as is used for withdrawal. If, before the supply vessel is emptied, the clamp is applied and the stopcock



reversed, the siphon remains full and ready for use as before.

One advantage is that the carboy need never be uncovered, and any air entering the system must do so through the air inlet, which may be provided with a filter. All contacts between glass and cork are sealed with rubber cement.

Using a ¼-in. filter pump working with 50-lb. water feed pressure and lifting against a 3-ft. head, the charging rate is about a liter per minute.

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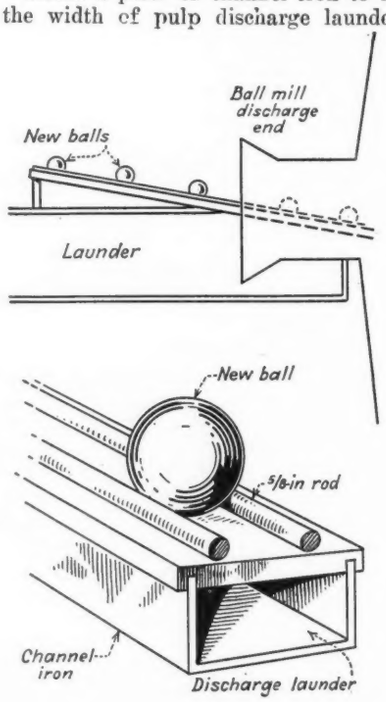
Adding New Balls to Grinding Mill

SOME BALL MILLS are so placed as to make it difficult to feed new balls into the pulp intake end, writes L. E. Bruno, Getchell mine, Redhouse, Nev. Where such conditions exist the new balls may be added to the mill through the discharge end by using the simple device shown in the cut, which is made as follows:

Notch a piece of channel iron to fit the width of pulp discharge launder



and weld to it two pieces of ⅝-in. steel rod, spaced to trough the smallest size new balls so they will not fall between the rods, and spot-weld spreaders under the rods to hold them to gage. A little experimenting may be necessary with the length of the feeder to obtain the proper angle at which the new balls will roll down the incline into the mill. Once this angle is found and the lower end of the feeder is placed well inside the mill, the new balls may be quickly fed into the discharge end of the ball mill.

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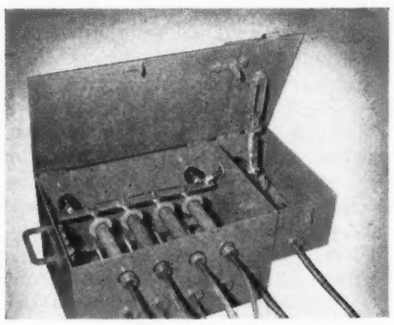
Safety Junction Box For D.C. Power

A SAFETY FUSED JUNCTION BOX in which neither the positive nor negative connections can be disturbed unless the power is off has been designed and built by a mining company employee for underground conveyor operations using d.c. power. The box has two compartments. The lid is in two parts and the one attached to the incoming quick-break entrance switch of the positive line laps over the other and thus must be closed last. A slide rod inside of the box and which locks the large compartment door at its center extends



into the switch compartment and must be pushed into locking position before the switch door can be closed. Hasps for a padlock complete the closing and locking arrangement.

In the larger compartment are two copper buses each with bolt holes for four take-off taps. Each negative is connected to the lower bus by a knuckle-joint connector, half of which is bolted permanently to the bus. Each positive feeder includes a fused tap with its nip end bolted to the upper bus. Four special tap fuses, 600-volt type but also used on 275 volts, are kept as spares in a clip inside of the box. Both buses are supported on the back of the box by Dirago spool insulators such as used in standard mine hangers. On the lower or negative bus the spools are used for convenience and appearance in mounting rather than as insulators. The insulation, however, does adapt the box to an ungrounded two-wire system if such is desired.

PERSONAL ITEMS

Alex Maguire has resigned from the staff of Sheep Creek Gold Mines, Ltd., and returned to the United States.

Henry Shelton is mill superintendent for the Molybdenum Corporation of America at the Boriana mine, Yucca, Ariz.

E. R. Lovell, general manager of the Calumet & Hecla Consolidated Copper Co., has been elected a director of that company.

Harold Lakes, Nelson, B. C., mining engineer, has been elected president of the Chamber of Mines of Eastern British Columbia.

G. C. Riddell is in Mexico and California for the month of April, engaged in quicksilver and antimony investigations.

Peter P. Ribotto has been promoted to the post of chief engineer for the Northern Michigan iron mines of the Inland Steel Co.

L. A. Norman, Jr., of Sutter Creek, Calif., has been appointed superintendent of the Central Eureka Mining Co. at Sutter Creek, Calif.

T. A. Lynch, sales manager for the aeronautical industry for Reynolds Metals Co., Inc., has been elected a vice president of that corporation.

George M. Lee, last smelter superintendent for the Granby company at Anyox, is now associated with Ventures, Ltd., and is living in Vancouver.

Grover J. Holt, who has long been associated with Butler Bros., of St. Paul, Minn., has become affiliated with the Cleveland-Cliffs Iron Co.

Charles V. Harris has been advanced to the position of division engineer for the Tennessee Rock Department of the International Minerals & Chemical Corp.

C. M. Willington, who has been general manager of the Mt. Kasi Mines, Ltd., in the Fiji Islands, has resigned his position and joined the Royal Australian Air Force.

George M. McCoy has left the Willow Creek mines, at Luckyshot, Alaska, where he was mine shift boss, and is now employed as an engineer by the Boeing Aircraft Co., Seattle, Wash.

The Hon. Rolf W. Bruhn, president of Sheep Creek Gold Mines, Ltd., has resumed his duties as Minister of Public Works in the British Columbia Government, following a serious illness.

W. S. Ellis, former superintendent of the Reno mine, in the Sheep Creek district, has now taken charge of the Reno subsidiary operation, Central Zeballos Gold Mines, Ltd.

Leroy Harrington, of Benton, Ark., has left for British Guiana to open a bauxite mine and put a preparation plant into operation. The mine will be known as the Kwakwani.

J. Allen Howe has been elected president of the British Institution of Mining and Metallurgy for 1942-43, and **Dr. J. G. Lawn** has been chosen secretary-treasurer.

A. L. Flagg, of Phoenix, Ariz., was in New York recently, after having come East for consultation regarding vanadium with the Materials Division of the War Production Board in Washington.

Ing. Wens. Pacheco E. has resigned his position with Compañia Minera Unificada del Cerro de Potosi and has accepted a position as professor of ore dressing on the engineering faculty of Potosi University, Potosi, Bolivia.

J. Henry Reeder, recently superintendent of iron mines of the M. A. Hanna Co. at Iron River, Mich., has been made general superintendent of the Manganese Ore Co., a subsidiary of the M. A. Hanna Co.

William F. Hayden, consulting mining engineer, announces the removal of his offices from Grants Pass, Oregon, to 202-209 Perrin Building, 767 East Big Bend, Webster Groves (St. Louis), Mo.

Thomas Bostick, formerly mill superintendent for the First Thought Mine Corp. at Orient, Wash., is acting assistant mill superintendent for New Goldfields of Venezuela, Ltd., Ciudad Bolivar, Venezuela.

Solomon Lieb has been advanced from the position of metallurgist to that of mill superintendent and metallurgist of the flotation plant of Cia. American Smelting Boliviana, Ltda., at Corocoro, Bolivia.

Worthen Bradley, of San Francisco, has been elected president of the newly organized California Chapter of the American Mining Congress. Vice presidents elected were **Russell Mumford** and **R. E. Tremoureux.**

H. L. Batten, manager of Canadian Exploration, Ltd., which suspended activity in line with other subsidiary companies of Placer Development, Ltd., as a result of the invasion of New Guinea, is now engaged in war work at Ottawa.

Robert A. Bryce, president of Macassa Mines and a director in other Canadian properties, has been installed as president of the Canadian Institute of Mining and Metallurgy for the 1942-43 year. He succeeds **W. G. McBride.**

A. J. Zinkl, until recently on the staff of E. I. duPont de Nemours & Co., at Choteau, Okla., has accepted a special assignment as defense construction engineer with Iron King Mining Co. at Humboldt, Ariz.

W. E. Jones, formerly assistant chief engineer of the Climax Molybdenum Co., has been appointed safety director of the same organization. Mr. Jones is succeeding **James K. Richardson** as safety director.

C. W. Nichols, former president of Nichols Copper Co., now Phelps Dodge Refining Co., has been appointed a vice president and director of the salvage division of Metals Reserve Co. at Washington, D. C.

G. Chesterfield Evans wrote under date of Jan. 4 from Mangani, Pajacombo, Sumatra, N. E. I., that he expected shortly to leave for Australia, where his address would be 36 Bulkara Road, Bellevue Hill, Sydney. His letter was about ten weeks en route.

Austin B. Clayton, section superintendent for the Bolivian Tin & Tungsten Mines Corp. at Huanaui, Bolivia, having completed a three-year contract, resigned at the end of March. He expects to return to the United States, where his address will be Sandpoint, Idaho.

W. B. Maxwell, formerly general superintendent of Granby operations at Anyox and subsequently manager of Beattie Gold Mines, Ltd., in Quebec, was recently in Vancouver in connection with the option acquired by Ventures, Ltd., on the Anyox smelter and plant.

H. A. Lever has been appointed assistant chief mining engineer of the Department of Conservation of the State of Minnesota. He succeeds **E. G. Kremer**, who left St. Paul, Minn., recently to enter the service of the Federal Government abroad.

Sherwin F. Kelly, geophysicist, delivered three lectures under the John Markle Foundation for Mining Engineering at Lafayette College, Easton, Pa., on March 24 and 25. His final discussion was on the subject, "The Role of Geophysics in the Production of War Materials."

H. V. Warren, associate professor of geology and geography at the University of British Columbia, has returned to Vancouver after an extensive trip to eastern Canada and the United States. In an informal address before the Walker Mineralogical Club of the University of Toronto, he reviewed recent mineral developments in British Columbia.

William L. Kendrick, of Ely, Minn., has been promoted by the Oliver Iron Mining Co. to the position of assistant superintendent of the Trout Lake concentrator, at Coleraine, Minn. For the past few years Mr. Kendrick had been efficiency engineer for the Oliver on the Vermilion Range.

Prof. C. K. Leith, of the University of Wisconsin, at present adviser to the Materials Division of the United States War Production Board, has been giving a series of ten lectures under the auspices of the division of geology and

geography of Columbia University, entitled "Minerals in Peace and War."

Ethelbert Dowden, Carrel B. Larsen, and **Kenneth Welker,** American Mining engineers employed by the Office of the Coordinator of Inter-American Affairs, arrived in Lima, Peru, in February, and will cooperate with that country in increasing the production of minerals essential to the war industries.

Chris G. Dobson, who was manager of the Cornucopia Gold Mines, in Oregon, until its recent closing down, is now with the Reconstruction Finance Corp. in Washington, D. C. Previously Mr. Dobson was for many years with Howe Sound Co. at Britannia Beach, B. C., where he was superintendent.

John F. Cowley, formerly with the Idaho Maryland Mines Corp. at Grass Valley, Calif., and for the past two years manager for the West Coast Mines, Inc., in Humboldt county, Nev., has resigned to accept appointment as an examining engineer for the mining division of the RFC and is now in Washington.

James R. Evans, mining engineer of the Metals Reserve Co. of the Reconstruction Finance Corp., is in Little Rock, Ark., in connection with a bauxite survey in Saline, Pulaski, and Grant counties. His headquarters are in the local RFC office in the Pyramid Building, Little Rock.

Gordon F. MacDonnell, British Columbia manager of Conwest Exploration Co., Ltd., has been transferred to his company's Toronto office. During his residence in British Columbia, Mr. MacDonnell was identified with the Privateer and Mount Zeballos mines as well as many prospects.

Clarence A. Wright, recently with the Export Control Administration, is now in the tin-lead branch of the WPB at Washington, D. C. For some years prior to his connection with the Export Control Administration he was engaged in exploiting a kyanite deposit in Virginia, which was finally taken over by the Kyanite Products Corp., a subsidiary of International Minerals & Chemical Corp.

Dr. William B. Fulton, senior surgeon in the United States Public Health Service Reserve, and former director of the Bureau of Industrial Hygiene of the Pennsylvania Department of Health, has been appointed chief of the Health Division of the U. S. Bureau of Mines. He will direct the Bureau's activities in safeguarding the physical welfare of the nation's workers in the mineral industries.

W. R. Coleridge Beadon recently left New York for West Africa to take control of the Overseas Engineering Co. of London, which has offices at Sekondi, on the Gold Coast, and Lagos, Nigeria. Mr. Beadon has spent most of his professional life in the Far East, where he was one of the pioneers of the Tavoy wolfram industry, which played an important part in the first World War.

William D. Webb, mining engineer at the Mahoning mine, Hibbing, Minn., has been appointed superintendent of the Majorca mine, Calumet, Minn. Both of these properties are operated by Pickands, Mather & Co. Mr. Webb is a graduate of the Michigan School of Mines and has been in the employ of Pickands, Mather & Co. for the past 18 years.

D. C. Sharpstone, manager of Canbrae Exploration Co., Ltd., and well-known consulting engineer, who recently obtained for the Canbrae company an option on a placer-gold and tungsten property in the Yukon Territory, has returned to Toronto prior to leaving for Rhodesia and South Africa, where he will act for the United States Government's Metals Reserve Co. and the State Department.

James K. Richardson has been appointed secretary of the Tri-State Zinc and Lead Ore Producers Association as of April 1. He takes the place of **Evan Just,** who has served as secretary of the Association for the last five years. Mr. Just is leaving to join the staff of *Engineering and Mining Journal.* He will remain in Joplin to assist Mr. Richardson during the current month.

John A. Church, who before joining the service of the Federal Government was a consulting mining engineer of New York, and who organized the copper and zinc branch for the old OPM, has been commissioned a major in the Army and assigned to the Army-Navy Munitions Board in the office of the Under Secretary of War. In his new post Major Church will act for the Army in copper matters.

H. M. Kingsbury recently returned to New York by plane from South America, where he has spent the past six months in Peru and Brazil on examination work for the American Smelting & Refining Co., having flown to Lima on Oct. 8 last. During the previous nine months he had been engaged in a geological study of the Silverbell district in Arizona for the American Smelting & Refining Co.

F. G. Pardee, appraiser of mines for the Michigan Tax Commission, who has been on special duty in South America for more than a year for the Federal Government, is expected to return early in April to resume his regular duties. **G. E. Eddy,** who has been handling the mine appraisal work during the absence of Mr. Pardee, has been summoned for duty with the Coast Artillery. He is an officer in the Reserve Corps.

Gloyd M. Wiles, general manager of Park City Consolidated Mines Co., has resigned to become consulting engineer for the St. Louis Smelting & Refining Co. **Allan R. Reiser,** chief geologist for Park City Consolidated, has been made general superintendent at the Park City mine. Before going to the Park City property in 1934 Mr. Wiles had been associated with Granby Consolidated at Anyox, B. C.; Bunker Hill & Sullivan Mining & Concentrating Co. at Kellogg, Idaho; Sudbury Basin Mines, in Ontario; and Bell Telephone Laboratories at New York City.

A. C. Carlton, curator of fuels and metals at the Museum of Science and Industry, Jackson Park, Chicago, has been granted temporary leave of absence to assist the War Department in the production of ammunition. Mr. Carlton's assignment with the Federal Government, under Civil Service, is in the small-fuse and primer section, ammunition division, of the Chicago ordnance district. He is a member of the A.I.M.E. and served as chairman of the Chicago section of the Institute in 1939-40.

B. I. Nesbitt has recently joined the staff of Kelowna Exploration Co. Ltd., a subsidiary of the South American Development Co., and is located at the Nickel Plate mine, at Hedley, B. C. Formerly he was in charge of geological work for Canadian Exploration, Ltd., a subsidiary of Placer Development. The loss of Bulolo to Japanese attacks on New Guinea made it advisable for Canadian Exploration to cease exploratory and development work for the duration of the war.

George C. Branner, State Geologist of Arkansas, has been called to active military duty with the Quartermaster Corps Reserve. He holds a commission in this service as a lieutenant colonel. Governor Adkins of Arkansas has granted Colonel Branner a leave of absence and has appointed **Richard J. Anderson,** Assistant State Geologist, to act in Colonel Branner's place, stating, "The vacancy in the office probably will not be filled." Colonel Branner has been a member of the Reserve since 1922 and has had four tours of active duty. During the first World War he served as a first lieutenant in the Army ambulance service.

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OBITUARY

Russell F. Collins, a prominent mine operator of the Northwest, died recently at Leevining, Calif.

Miles Miller Carpenter, secretary of the Tucson, Ariz., Council of the Arizona Small Mine Operators' Association, died in Tucson on March 20. He was 60.

George A. Marsh, a pioneer in the smelting industry of Colorado since 1900, died in Pueblo, in that State, recently at the age of 83.

Edward T. Fishwick, vice president and director of Worthington Pump & Machinery Corp., died on March 15 at Glen Ridge, N. J. He had been with the organization for 49 years.

Edgar Taylor, a prominent British mining engineer of a generation ago, who distinguished himself with the development of the Kolar gold field, died recently in England. He was 84 years old.

George Mathias Winkelman, 75, president of the Aluminum Potash Company of America, died on Feb. 4 in Salt Lake City, Utah. He went to Salt Lake

in 1919 to develop alunite deposits at Marysvale.

W. L. Haehnlen, president of the Tonopah Mining Co. of Nevada and of the Tonopah & Goldfield Railroad Co., died on March 12 at his home in Philadelphia. He had been an officer or director of the two Nevada companies for many years.

John Alexander Lindsay, who was in the service of the Broken Hill Proprietary Co. for 43 years, during 33 of which he was chief engineer to the company on its Broken Hill mine, died on July 27 at Whyalla, South Australia, where he was living in retirement.

Omer A. Weston, a mining engineer of Skull Valley, Ariz., died at Prescott, Ariz., on March 11, at the age of 62. Mr. Weston had lived in Yavapai County since 1898. For several years he was manager of the old Boston-Arizona mine, in that county.

The Hon. Robert Randolph Bruce, former Lieutenant-Governor of British Columbia and Canadian Minister to Japan, died on Feb. 21. In addition to his successful development and management of the Parridice mine in the Windermere Mining Division, he was a charter member of the C.I.M.M. and a councillor of that body in 1921 and 1922.

Hugh Fitzalis Kirkpatrick Picard, a British metallurgist and consultant, who had been associated with gold, lead, zinc, and copper production in Canada, Australia, and the United States, died on Jan. 24 at the age of 71. He was a graduate of the Royal School of Mines and a past president of the British Institution of Mining and Metallurgy.

James Hebbard died in Adelaide early in the last month. Mr. Hebbard was mine manager of the Sulphide Corporation's Central mine in Broken Hill from 1902 until his retirement in 1925. He was intimately connected with the development of the flotation process from its inception and did much valuable work in connection with its elaboration and application.

Ronald Harris, a distinguished mining engineer of international reputation and achievement ,died on March 11 in Toronto, Ont., at the age of 68. Mr. Harris was associated with Cecil Rhodes in Africa and had worked as a mining engineer in Cobalt, Alaska, Quebec, British Columbia, Bolivia, and Mexico. He was a member of the A.I.M.E. and the Canadian Institute of Mining and Metallurgy.

Kenneth Williams, general foreman of Noranda Mines smelter, died on Feb. 4 at the age of 59. During his school years he majored in chemistry and after graduation he worked for a time in Utah. Next, he spent four years teaching in the University of Pennsylvania, leaving the University to go to Peru, where he was associated for four years with Cerro de Pasco. On the termination of his work for that company he returned to the United States and held positions at the Copper Queen smelter at Douglas, Ariz., and at Humboldt, in the same State. In 1932 he went to Noranda. He held his position there until the time of his death.

John D. Galloway, general manager of Base Metals Mining Corp., Ltd., died on Feb. 21 last. Mr. Galloway, who was 52 years old, was born in New Zealand and came to British Columbia at the age of ten. An honor graduate of McGill University, he served 20 years with the British Columbia Provincial Department of Mines, first as assistant mineralogist, later as resident engineer, and finally as provincial mineralogist, resigning in 1934 to practice as consulting engineer. He was a councillor of the C.I.M.M. in 1926 and 1927 and vice-president and chairman of the British Columbia Division from 1928 to 1930; a Fellow of the Royal Society of Canada, as a geologist; and a past president of the Association of Professional Engineers of British Columbia.

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LETTERS

Valuation of Future Profits

The following comment concludes the discussion on "Valuation of Future Profits" published in previous issues this year.—Editor.

The Editor:

I APPRECIATE the comments of Mr. Harding on my article which appeared in the November 1941 issue of *E.&M.J.*

For the third year the figure in column B is a typographical error and should have been 1.229874, but for the seventh year—if he will recheck his figures—he will find that my calculations are run out correctly.

For the ninth year it might give an auditor a headache to place $2,113 in a sinking fund when anticipated profits amount to but $2,000, and undoubtedly it would be easier to rearrange the assumed annual income as set up in the hypothetical case rather than draw said $113 deficit out of cash on hand. However, I appreciate Mr. Harding's criticism on the point. In this hypothetical case the annual income should have been arranged to provide the necessary return to place in the sinking fund account.

I did not intend to recommend calculation of variable income to present worth for valuation purposes instead of averaging profits over the life of the property, and using Hoskold's factors. In some instances as in a liquidating mine where the expected profits may be much larger during the first few years, the present value is greater than average profits discounted to present worth.

Hoskold's factors are tabulated for income up to 25 percent, but I have seen no tables with the rate of interest on a sinking fund less than 3 percent. With the low rates of interest now paid on available money it is probable that 2 percent is a more reasonable figure to use.

The Hoskold factors can be obtained by the same method as set up in my tabulation on variable income by making the annual income $1 per year. The resultant figures from AxB will be $11.463879 — 0.68783274V = *V*, or *V* = $6.7921 for a $10 income averaged over a ten-year period. The Hoskold factor will therefore be 6.1921 ÷ $10 = 0.61921, which is the factor that may be taken from Hoskold's discount factor tables. Should a 2 percent interest rate on the sinking fund be desirable, a Hoskold discount factor may be worked out by changing the compound interest factors to 1.02 instead of 1.03.

C. E. MILLS
Jerome, Ariz.

The Editor:

RECHECKING Mr. Mills' calculations for the seventh year, I find that the product AxB is correct as printed. Our difference was caused by the use of the compound interest factor in his column B, which figure contains another typographical error. It should be 1.092727 instead of 1.1092727.

A. C. HARDING
El Portal, Calif.

Vanadium Pig Iron From Titaniferous Magnetite

The Editor:

ON PAGE 48 of your issue for February, 1942, you quote a Russian report which claims that a naturally alloyed vanadium pig iron has been produced from titaniferous magnetites for the first time in history. In view of the present demands for vanadium, attention may be called to work which was carried out at Queen's University during the period 1919-21 by W. M. Goodwin, under a grant from the National Research Council of Canada. A summary of the results was published by the Council in 1922 as Technical Report No. 8, entitled "A Method of Smelting Titaniferous Iron Ore" (a few copies of the report are still available at 25c. each).

The results of a typical run (out of a total of 24 made) are shown in the accompanying table. The ore used was a titaniferous magnetite from Ontario. A charge of 100 lb. of ore and 20 lb. of sand (carrying 69 percent SiO_2, 10.3 percent CaO, 2.6 percent MgO, and 8.3 percent Al_2O_3) was smelted in an electric furnace with 25 lb. of charcoal. The iron formed was gray, fine grained, and tough, and was readily drilled. The slag was fluid at 1,290 deg. C., and at 1,500 deg. C. was intermediate in viscosity between commercial blast-furnace slags made at Hamilton, Ontario, and Sydney, Nova Scotia. The retention of the vanadium in the pig iron is attributed to the substantial replacement of lime by titania in the slag. This also accounts in large part for the reduced elimination of sulphur, as compared with ordinary blast-furnace practice.

	Ore	Slag	Iron
Fe	48.22	2.9	....
SiO_2	7.40	35.6	....
CaO	3.42	8.1	....
MgO	4.73	10.8	....
Al_2O_3	5.81	15.9	....
TiO_2	11.80	25.6	....
MnO	0.29	0.6	....
V	0.34	Tr.	0.72
S	0.33	0.24	0.209
P	Tr.	0.001	0.028
C	....	....	2.56
Si	....	....	1.28
Ti	....	....	0.01

My attention has been called to your article by Mr. A. F. G. Cadenhead, Director of Plant Research for Shawinigan Chemicals, Ltd., who assisted Dr. Goodwin in the investigation in question.

F. E. LATHE
National Research Council, Ottawa, Canada.

Activities of Metals Reserve Co.

A report to the Secretary of Commerce on domestic production of strategic materials

Charles B. Henderson, President

IN THE DOMESTIC FIELD of critical and strategic minerals, Metals Reserve Co., in cooperation with the Reconstruction Finance Corp., and Defense Plant Corp., has been active in effecting very large increases in production of bauxite, chrome, manganese, tungsten, and vanadium. In the major nonferrous metal fields of copper, lead, and zinc, necessary increases in smelting capacity in zinc have been effected; substantial increases in copper production made through the larger companies; and the production from the numerous and important small producers of all three metals greatly stimulated by payment of substantial premiums over "ceiling" prices for a period of two and one-half years from Feb. 1, 1942. The details of this program are enumerated in the following:

ALUMINUM AND BAUXITE

Arkansas—Contracts have been made with American Cyanamid and Chemical Corp. and with Reynolds Mining Co. for production of 540,000 and 300,000 long tons per annum, respectively, of low-grade bauxite. Republic Mining & Manufacturing Co., a subsidiary of Aluminum Company of America, is proceeding with stripping operations preliminary to increased production, and with several small producers will supply the balance of approximately 840,000 long tons per annum required for the billion-pound alumina plant now under construction in Arkansas. Plans are proceeding for possible increase in production of high-grade bauxite in Arkansas to 2,000,000 long tons per annum, and for stockpiling any excess of current production over consumption. The above program represents a total increase of approximately 200 percent over 1941 domestic production of bauxite, and is scheduled to keep pace with increasing requirements for aluminum.

In addition, our engineers are making studies on the ground in Arkansas in connection with possible emergency production from Arkansas far in excess of the above program.

ANTIMONY

Idaho—Negotiations are in process with Sunshine Mining Co. for a metal contract in connection with expansion of production at its new property from 30,000 lb. to 150,000 lb. of antimony per month. Discussions are proceeding with the Bradley Mining Co. for possible production from the large low-grade antimony deposit surrounding its rich tungsten mine.

Texas—Contracts made with the Texas Mining & Smelting Co. have permitted that company to make a large increase in imports of Mexican antimony ores, for metal production in Texas.

Domestic production of antimony continues to supply only a small proportion of domestic requirements.

CADMIUM

The increase in facilities for electrolytic zinc production being made in Montana and Missouri will permit the recovery of substantial amounts of cadmium contained in zinc concentrates.

Bagdad Copper Co.	
Calumet & Hecla Consolidated Copper Co.	
Gray Eagle Mining Co.	
Miami Copper Co. (DPC)	
National Tunnel & Mines Co.	
Phelps Dodge Corp. (DPC)	
Totals	

CHROME

Alaska—A contract has been made for delivery of 20,000 tons of high-grade ore during the summer of 1942. Cooperation has been extended to the same producer for production of 400 to 500 tons per day of milling-grade ore, and arrangements made to mill this tonnage in Alaska.

California—The Grey Eagle mill, in Glenn County, started operations in March, 1942, under arrangement with Reconstruction Finance Corp. and Metals Reserve Co., at the rate of 15,000 tons of metallurgical grade concentrates per annum.

California-Oregon—Arrangements have been made for purchase of chrome ores from small operators in truck-load lots from the numerous small chrome deposits of northern California and southern Oregon. Stockpiles and sampling facilities will be available at many locations in this relatively inaccessible area.

Montana—A major development and production program is being carried out by Defense Plant Corp. and Metals Reserve Co., with Anaconda Copper Mining Co. in charge of construction and operations. One mill went into operation March 1, 1942, on a basis of 60,000 short tons of concentrates per annum, and plans are under way for increasing present capacity by 150 percent before the end of 1942. Another mill is expected to be in operation before the end of this year on a basis of 150,000 tons of concentrates per annum, with the possibility of further increase in capacity in 1943. Still another property is expected to be in production at the rate of 60,000 tons per annum by the end of 1942. Prospecting and development of other areas will be carried forward this year as soon as weather permits. This production rate of 360,000 short tons per annum from these three Montana properties alone by the end of 1942 compares with the previous peak United States production figure of 92,400 short tons, achieved in 1918.

Oregon—A mill for recovering chromite from bench gravels is well under way, under contract to deliver 30,000 tons of chemical grade concentrates per annum to Metals Reserve Co.

Wyoming—Arrangements have been made for erection of a 400-ton mill by private interests involving production of 35,000 tons of concentrates per annum under contract with Metals Reserve Co.

COPPER

At the request of the War Production Board and with the approval of the President, Metals Reserve Co. has agreed to pay a premium of 5c. per pound for "over-quota" production of domestic copper. It is expected that this will enable some mines to operate which could not operate profitably at the ceiling price of 12c. per pound, and will permit numerous small individual operators to expand their production greatly.

Location	Production, Tons Per Year	Government Capital Commitment
Arizona	10,200	$2,500,000
Michigan	1,250	.....
California	6,800	.....
Arizona	23,000	9,000,000
Utah	5,000	.....
Arizona	60,000	28,500,000
.....	106,250	$40,000,000

Arrangements have been made for expansion of domestic copper production as shown in the table above.

The aggregate increase in domestic copper production may well be 200,000 tons per annum.

GRAPHITE

Reconstruction Finance Corp. loans have been granted to the four principal producers in the Alabama, Texas, and Pennsylvania fields, and further investigations are under way in Chester County, Penn.

LEAD

Arrangements have been made to pay a premium of 2¾c. per pound on "over-quota" production of lead, for a period of two and one-half years from Feb. 1, 1942. Substantial stimulation of small mine production may be expected to result from the premium price of 9.25c. per pound, which is in excess of the highest average price level for lead in 50 years.

MANGANESE

Arizona—The owners of the major portion of the large manganese reserves in Arizona are carrying out experimental work in a large pilot plant, and will submit preliminary plant designs and cost estimates with the view of entering into the necessary contracts with Defense Plant Corp. and Metals Reserve Co. to bring this large property into production.

Arkansas—Arrangements are being made for construction of a concentrating plant of 300 to 500 tons' daily capacity.

Minnesota—The production of manganese from the "black ores" of the Cuyuna Range has been dependent upon the satisfactory solution of the metallurgical problems involved. After six months of pilot-plant operation conducted under the auspices of Metals Reserve Co., it has been decided to use sulphuric acid leaching for this ore. Negotiations are proceeding for erection and operation of plant and for ore delivery for a plant of 200,000 tons per annum of 60 percent manganese nodules.

Montana—Anaconda Copper Mining

(*Continued on page* 80)

Canadian Institute Convenes In Toronto

Annual meeting draws good attendance despite the war

REGISTRATION of members, delegates, and visitors at the 46th annual general meeting of the Canadian Institute of Mining and Metallurgy, held in Toronto at the Royal York Hotel March 9 to 11 inclusive, compared favorably with that of other years, in spite of the distracting influences of the war, now two and a half years old, in which the Empire finds itself. By the end of the third day the list contained the names and addresses of approximately 1,000 individuals, who had come from all parts of the Dominion, though mainly from the Eastern Provinces. The program provided a judicious mixture of technical sessions and social affairs, including entertainment for the ladies.

The inaugural session, with W. G. McBride, president of the Institute, in the chair, was marked by the presentation of two trophies to be awarded annually by the Institute for achievement in safe mining. The gift of Mine Safety Appliances Co. of Canada, Ltd., in memory of the late John D. Ryan, these consist each of a bronze group on a sculptured bronze base, one for "the metalliferous mine achieving the best safety record in Canada during the year preceding the presentation" and the other for the coal mine making a similar record. Award for 1941 was made to the Chesterville Larder Lake Gold Mining Co. Ltd., in the case of the one trophy, as announced subsequently at the Institute dinner. No award was made for the past year, however, in the coal industry.

Activities of the Dominion's Wartime Bureau of Technical Personnel were discussed by Col. G. E. Cole at the opening session. This work, "done by engineers for engineers to mobilize the technical personnel of Canada for war purposes," has consisted in assembling information regarding chemists, engineers, and research workers by means of a questionnaire. Judging from the replies now on file, the speaker said, the Dominion is very short of such men.

W. H. Losee, of the Dominion Bureau of Statistics, presented a preliminary report on Canada's mineral production in 1941. He pointed out, in passing, that the large deposits of base metals were being depleted rapidly and also that the country was now confronted with the need of producing some strategic metals.

A paper on use of alloy steel in rock drilling, prepared by C. G. Kemsley, mechanical superintendent for Dome Mines, Ltd., brought the first session to a close. The author told of the decrease in breakage resulting from the adoption of a 1 percent carbon steel containing chromium and molybdenum, in place of straight carbon steel. Twenty-two producing mines in the Porcupine, Kirkland Lake, and northwestern Quebec districts had standardized on this alloy steel with good results. Angus D. Campbell, superintendent of Omega Gold Mines, at Larder Lake, rose at the end of Mr. Kemsley's remarks, to say that the work described was a contribution to research on the part of the gold mining industry.

At the Institute luncheon following, Dr. G. B. Langford presided. After speeches of welcome by the Mayor of Toronto, Ontario's Acting Minister of Mines, and the President of the Board of Trade, the delegates from the various provinces were called upon in succession for a word by Dr. H. C. Rickaby, Deputy Minister of Mines for Ontario. Referring to the "V for Victory," Dr. Rickaby, in the course of his remarks, said that he liked to think of the great "V" of Pre-Cambrian rocks inclosing Hudson's Bay and having its base at Ottawa and what it meant toward winning the war.

Three papers were heard at the afternoon session, at which M. W. Hotchkin presided. Dr. A. B. Yates, geologist for International Nickel Co. of Canada, discussed the topic of rock bursts on behalf of the Ontario Mining Association, which, he said, now had a most complete library on this topic. He then showed slides illustrating the application of photoelastics to the study of underground rock pressures and the demonstration of the doming theory. Here may be mentioned the award of the Inco medal, announced later at the dinner, to R. G. K. Morrison, for his notable report on the "Rockburst Situation in Ontario Mines," prepared for the Ontario Association, which has just released it for early publication in the C.I.M.M. *Bulletin*. It is described as a veritable textbook on the subject. A prepared discussion dealing with Lake Shore's experience with rock bursts was then presented by Dr. Gibbs, following which Ontario's Chief Inspector of Mines, W. O. Tower, gave some figures showing the prevalence of rock bursts in the mining industry.

"Ventilation as a Means to Prevent Silicosis in Ontario Mines" was the topic, next, of C. S. Gibson, engineer and secretary of the Ontario Association's technical silicosis research committee. He dealt with "certain salient aspects culled from field observations," the data in all cases referring to gold mines. These data, incidentally, afforded a good picture of current ventilation practice in the Province.

Supplementing Mr. Gibson's contribution, the remaining paper, on "Dust Quantitation," was presented in two parts by the joint authors, D. H. Hamly and P. F. Pullen, Dr. Hamly outlining the development of projector and comparison counting and Mr. Pullen, ventilation engineer for Kerr Addison Gold Mines, discussing practice employing it in Ontario.

Technical sessions were resumed Tuesday morning, J. G. Hardy presiding. Anton Gronningsater, consulting metallurgist for Falconbridge Nickel Mines, dealt with the operation of a basic converter, in a paper by himself and P. R Drummond, also with Falconbridge. Discussion following was participated in by J. R. Gordon, research manager of International Nickel, at Copper Cliff; W. B. Boggs, superintendent of the Noranda smelter; E. A. McEwan, professor of metallurgy at McGill, and others.

Next, the paper on "Diamond-Drill Stoping at Waite Amulet," by A. A. McCloskey, printed in the November, 1941, *Bulletin* of the Institute, was presented. The remaining paper of the session, by Peter Price, dealt with the geology and ore deposits of Waite-Amulet.

During the meeting a proposal to form a geology section of the Institute was considered and defeated.

Metals Controller Talks

At the luncheon on Tuesday, at which E. A. Collins, of the International Nickel Co. of Canada, presided, addresses were made by Eugene McAuliffe, president of the A.I.M.E., and G. C. Bateman, Metals Controller for Canada, after a representative of the National War Finance Committee had told inspiringly how the recent loan would go over $1,000,000,000.

Mr. Bateman, who is also still secretary of the Ontaria Mining Association, needed no introduction. He discussed the question of supply of metals and minerals, saying that there was a very great shortage from the viewpoint of over-all requirements and that there had been failure in both the United States and Canada to realize how serious the situation was. There was only one course, he said, and that was drastic curtailment of non-essential uses, whatever its effect upon the national economy. A tremendous toll was being taken of the vanishing ore reserves. He then turned his attention to the strategic metals, particularly to chrome, tungsten,

manganese, and tin. In concluding, he said that the gold mines were among the casualties of the war, that other considerations must have precedence.

Following Mr. Bateman, Thomas Alexander Crerar, Dominion Minister of Mines, talked briefly of the war situation, saying that there was never a time in the history of the country when people needed so much to go into the quiet places and think; that we needed all our forces and powers and must keep a cool head and steady nerves.

Professor McBride, the retiring president of the Canadian Institute, delivered his address that afternoon, A. A. MacKay occupying the chair. Citing various faults of the Canadian mineral industry, though also saying they were shared by other industries and nations, he urged that they be corrected. The effort to get a mine into production too soon, before the proper preliminaries had been carried out, particularly received his attention; likewise the importance of recovering byproducts, the need for fundamental research, and the high losses in tailings, slags, dust, and solutions.

A lecture on "Powder Metallurgy" by Prof. John Wulff, of Massachusetts Institute of Technology, terminated the session. It was supplemented by demonstration experiments.

The annual dinner of the Institute, held that evening, was the occasion for awarding honors, including those for prize-winning student papers and others already mentioned. The award established by E. A. Collins for outstanding bravery was given to Maurice Gelinas, a machine-drill helper in the Normetal mine, for rescuing the drill-runner from danger at the risk of his life.

On this occasion was celebrated the 100th Anniversary of the Dominion Geological Survey. The toast, " a century of service," proposed by the president and Dr. G. L. Laughlin, of the U. S. Geological Survey, was the opportunity for an address by the latter in the course of which he said that whereas the U. S. Geological Survey's work followed the development of the West, the Dominion's Survey had led in developing its North and West, the men doing it obtaining honor in their own country without profit. Dr. Charles Camsell, Deputy Minister of Mines for the Dominion, made fitting response.

The incoming president of the C.I.M.M., Robert A. Bryce, was introduced. He expressed his thanks for the honor shown him, saying he would try to live up to the new responsibility.

Non-metallics commanded attention at the last of the technical session on Wednesday morning. Norman B. Davis presiding. W. B. Timm, Director of the Mines and Geology Branch of the Dominion Department of Mines, dealt with the subject of Canada's "industrial" minerals. Concluding, he took the opportunity to tell what had been done in Canada in respect to strategic minerals. The greater part of the current field year had been devoted to a study of possible sources, and in the coming year the entire staff would concentrate on this work, including a study of oil structures as well. He cited the plans to produce magnesium from dolomite as a result of Dominion efforts. What was being done, he said, compared favorably with similar work in the United States.

Barite occurrences and production at Pembroke, Nova Scotia, were next discussed by K. J. Springer in a descriptive, non-technical paper. The project is the result of prospecting entered upon only two years ago.

Magnesium and magnesia and their Canadian sources provided the topic for M. F. Goudge, of the Dominion Bureau of Mines. Two new plants would soon come into production, he said, using brucite and dolomite, respectively, as raw materials.

The concluding paper, by K. H. Braithwaite, dealt with fiberglass.

Institute affairs, including the formal induction of the president elect, Mr. Bryce, occupied the afternoon. The annual dance came as the grand finale that evening in the Royal York's banquet hall.

Activities of Metals Reserve Co.

(*Continued from page* 78)

Co. is now producing for Metals Reserve Co. high-grade manganese nodules (60 percent Mn) from its beneficiation plant at the rate of 112,000 short tons per annum, and is making plans for increased production under its contracts to deliver to Metals Reserve Co. Arrangements are being made for construction of a concentrating plant in the Phillipsburg area.

Nevada—At the Three Kids property, Manganese Ore Co. is proceeding to erect and operate a leaching plant under contracts with Defense Plant Corp. and Metals Reserve Co. This property should be in production before the end of 1942 at a rate of 110,000 short tons per annum of high-grade sinter (63 percent Mn), at an expenditure for milling facilities by Defense Plant Corp. of approximately $5,500,000, and of $2,250,000 by Manganese Ore Co. for property, mining facilities, and preliminary stripping. It is expected that the above facilities may be expanded in 1943.

Arrangements are being made to provide milling facilities for the manganese deposit in other Nevada areas.

New Mexico—One company is now operating a small mill, and a second company designing a mill of 250 to 300 tons daily capacity. Both of these companies have contracts with Metals Reserve Co. for sale of their production.

South Dakota—The problems of the great low-grade Chamberlain deposit are (1) the recovery of nodules from the shales of the district, and (2) the conversion of these nodules into ferromanganese. For the first problem, steps are being taken to produce approximately 300,000 tons of 16 percent nodules per annum, which will either be stockpiled for the present, or blended with high-grade concentrates if required.

Utah—Metals Reserve Co. has concluded a contract with the owner of the principal ore area, who proposes to erect his own concentrating mill.

In addition to the above, Metals Reserve Co., has made 50 contracts for manganese production in 13 states.

MERCURY

Production of mercury has increased so rapidly both in the United States and Mexico under stimulation of price that no steps have been taken, nor are contemplated at the present time, for any substantial government financing.

MICA

A program is being evolved for establishment of buying offices in the principal producing centers of the domestic mica industry.

TUNGSTEN

Contracts have been made with three of the largest domestic producers of tungsten to permit substantial increase in their production, and similar contracts are being arranged with numerous other producers. A retreatment plant will be erected this spring in Utah which will permit the utilization of large tonnages of low-grade concentrates, much of which has hitherto not been recovered. Arrangements are being made for direct purchase of production from small producers. With the stimulation of a price of $24 per unit (of 20 lb.) and of the above measures, it is expected that domestic tungsten production will increase from approximately 6,500 tons in 1941 to a rate of approximately 19,500 tons by the end of 1942.

VANADIUM

Arrangements have been completed for the rapid development of several of the lead vanadate properties in the West, which were of no economic interest under normal conditions. A program is being developed for increasing the production of vanadium from the sandstone ores of western Colorado and eastern Utah. These two steps should result in an increase of about 60 percent in domestic vanadium production as compared with 1941.

ZINC

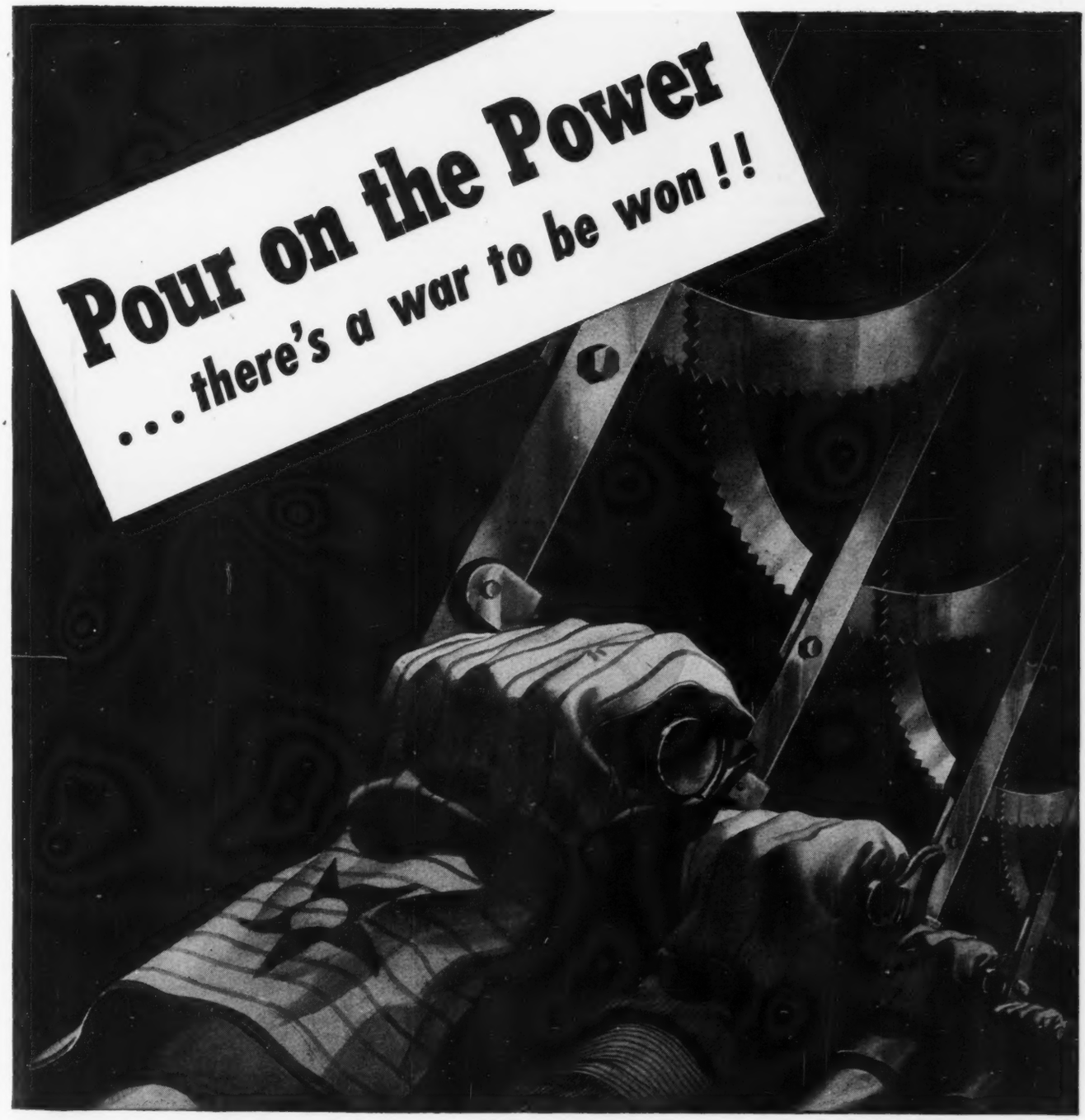
Expansion of domestic zinc smelting facilities has been effected by Metals Reserve Co. through contracts for the purchase of production or through agreements to make the necessary concentrate productions available, on the projects listed in the table below.

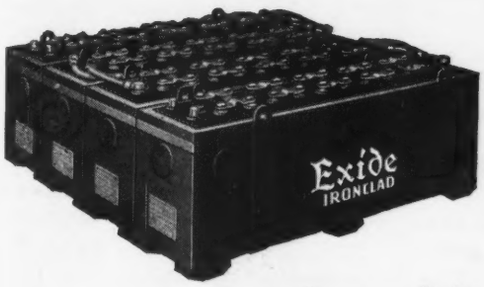
Through arrangements for continued supplies from foreign sources and through stimulus to domestic zinc production by the payment of a premium of 2¾c. per pound for "over-quota" production, concentrate supplies should be adequate to utilize existing smelter facilities and those made available by the program outlined above.

	Location	Added Capacity, Short Tons Annually	Financial Commitment
American Smelting & Refining Co.	Texas	25,000	None
American Zinc, Lead & Smelting Co.	Missouri	20,000	$4,500,000
Anaconda Copper Mining Co.	Montana	45,000	None
United Zinc Smelting Co.	West Virginia	14,400	750,000
Totals		94,400	$5,250,000

SALVAGE AND SCRAP

In addition to the steps enumerated above in respect to production of strategic and critical ores and metals, Metals Reserve Co. has taken steps in cooperation with the War Production Board for the requisitioning and reclamation of semi-processed materials which have been frozen by order of the War Production Board, and of numerous classes of scrap, such as automobile "graveyards," which can not move into consuming channels by ordinary business procedure.





WARS aren't won on battlefields alone. Behind the active fighting troops stands the army of production . . . but behind that army stands the miners who produce ores and minerals to strengthen the sinews of Mars.

Exide-Ironclad Batteries help by giving surging strength to storage battery locomotives, trammers and shuttle cars in mines. Underground, more Exides are used than all other makes of battery combined. Underground, as everywhere, Exide helps *Keep America Rolling.*

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THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

CALIFORNIA

Gold Mining Affected By Priority Rules

Denial of benefits of preference rating order P-56 may cause some gold mines to close when their present supplies are exhausted

▶ Western miners have much to think about. Pressure is coming from governmental sources to increase production of strategic minerals, but probably most disturbing is recent action on priorities position, more especially as relating to gold mining. Withdrawal of A-1-a rating under preference rating order P-56 from gold mines whose production is more than 30 percent gold has aroused the gold miners. On March 12, Western gold miners met at Reno, Nev., and vigorously protested the new position. Gold miners are divided, some voluntarily admit that under present war circumstances gold mining is not too important, but the other group is preparing to carry out a vigorous fight to retain operations and payrolls. Dr. Wilbur A. Nelson, mining branch administrator of the WPB, advised gold miners to get into something in line with defense work. Miners are fearful that many properties will have to shut down. The only comfort given at the meeting was that individual consideration would be given to existing operations.

▶ Labor and taxes are taking a heavy toll from gold mines. Idaho Maryland Mines Corp. has temporarily suspended dividends, although reserves are good. Preparations are being made to mine scheelite by Idaho Maryland at its Grass Valley properties, where 864 men are employed. A heavy labor turnover is reported from this area, war industries proving more attractive than mining to some men. It is stated that some 300 Grass Valley miners are now in Hawaii and that Dutch Harbor, Alaska, has also drawn another contingent for hardrock work.

▶ Central Eureka Mining Co. recently declared a 6¢ per share dividend payable March 14 last. Argonaut Mining Co., of Jackson, Calif., announced that as soon as present supplies and equipment are exhausted, the Argonaut mine will be shut down; the Empire Mine at Plymouth will also be shut down in July unless supplies are obtainable.

▶ Preparations are being made by W. J. Loring, managing engineer, to reopen the Alhambra mine, in the Kelsey district near Placerville. At Jacksonville, the old Eagle Shawmut property is reported under control of R. P. Miller, of San Gabriel, and others in a partnership that is considering resumption of operations.

▶ Placer and gold dredging operations are active. At Oroville the Golden Feather Dredging Co. is operating a dragline within the city limits in the bed of the Feather River. At Weaverville, a new "slack line" has been installed at the Del Loma workings on the Trinity River channel; L. Price is engineer in charge. The Placer Exploration Co. has optioned the Everett Carter and G. F. Lewman properties on Dutch Creek, in the Weaverville area, and is planning a sampling campaign. At Downieville, the William Richter dragline in Indian Valley has resumed operation. Snow conditions indicate a good hydraulicking season. The California Débris Commission has granted a hydraulic mining permit to the owners of the Pioneer, Comet, and Challenge mines, southeast of La Porte; operators are A. J. Just, A. J. Modglin, W. H. Pike, and R. F. Taylor.

▶ Keane Wonder mine, in the Death Valley area, has been shut down. The old property was acquired in 1938 by the Black Mammoth Consolidated Mining Co.

Two-cubic-yard Bodinson dragline of the Sumnar Dredging Co., of Oroville, Calif. A Caterpillar diesel-driven electric set furnishes power for lights, stacker pump and screen

ALASKA

Gold Dredging Operations To Open in the Spring

U. S. Smelting will run nine camps this season—Tungsten to be shipped from Hyder—Treadwell Yukon may liquidate and dissolve

▶ United States Smelting, Refining & Mining Co. will be running nine camps this season if the government does not take too many of its men for defense work. Its program includes the operation of its lode mine at McCarty. Dredges will be operated at Ester, Cripple, Goldstream, Pedro, Cleary, Fish Creek, Chatanika, and Little Eldorado. The company reports many married men and older men in the district available for the season's work. It has sufficient material and supplies on hand to start operations. Vice president and general manager Earling is expected to return from the east in April.

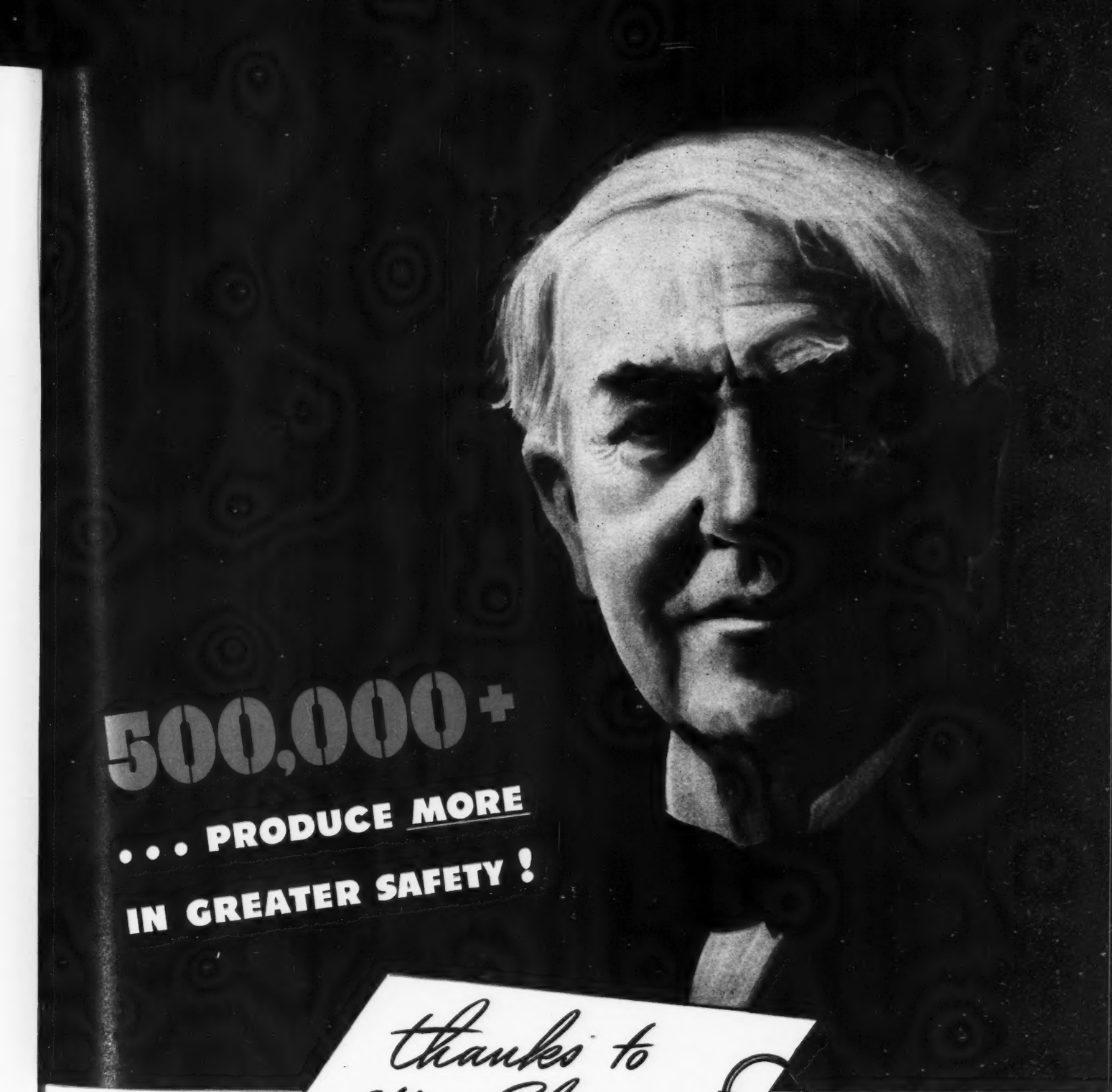
▶ The University of Alaska has made arrangements for an extension course in mining at Anchorage. John McAnerney is in charge. A short course in mining was conducted in the late winter at Fort Richardson, with two classes engaged in mineral testing. There were about forty in each class. Most of the students were enlisted men of the Alaska Defense Command. Experienced mining men and prospectors addressed the classes. Among these were Walter G. Culver, who was largely responsible for the platinum development in the Goodnews Bay area, and Leo Saarela, in charge of the Anchorage assay office. The spring enrollment showed 196 enrolled in the first week.

▶ Ben Leibrant, postmaster at Hollis, is preparing to operate the Puyallup mine, in that vicinity, and an old prospect on Maybesco Creek. Associated with him are Wendell Dawson and Kelton Adams.

▶ The Secretary of Commerce has waived the provisions of the Marine Act of 1920, which prohibited the transportation of tungsten concentrates from Hyder, Alaska, to United States reduction works. J. A. Scott says this waiver will permit him to ship the accumulated concentrates from the Riverside tungsten mine.

▶ Yukon Consolidated Gold Corp., Ltd., reports an operating profit last year of $960,000 before deductions for depreciation, amortization, and other charges. During the year the company expended $835,000 for non-profit work, including the completion of dredge No. 4 and stripping and thawing. The company says no capital expenditures of importance are planned for 1942.

▶ President P. R. Bradley of Treadwell Yukon Corp. has asked stockholders to consider the advisability of liquidating the company and eventually dissolving the corporation. The company has Canadian cash holdings amounting to 23c. per share in United States funds and a United States cash balance amounting to about 10c. per share. It would be necessary for the corporation to hold these funds in reserve pending the outcome of tax claims by the United States Treasury.



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COLORADO

Vanadium Production is Being Rapidly Increased

Cripple Creek mines planning reopening after connection with Carlton tunnel—Trucks equipped to keep concentrates from freezing—A. S. & R. Co. to drill Malachite property for copper

▶ The United States Vanadium plant at Rifle has completed and started one roaster, which handles 100 tons of vanadium ore in 24 hr. The second unit was to be in operation before April 1. Each section of the new plant, including crushing, leaching precipitation, and furnace units, has been tested and made ready for operation. This process is similar to the one used at the other plants of the company, and consists chiefly in crushing and pulverizing the vanadium ores, mixing with salt, and heating to 1,450 deg. The treated ore goes to the leaching plant and then to the precipitation tanks. The precipitate is dried and sent to the fusion furnace for the production of vanadium pentoxide. The U. S. Vanadium Co. has its own coal, salt, and vanadium mines in the southwestern part of the State, and another large treatment plant at Uravan.

▶ After having been shut down for over 20 years, the Greenwood shaft of LeClair Cons. Mines Co., on Gold Hill, Cripple Creek, has been opened by Louis Peiffer and Keith Johnson, and they are shipping ore from the first level, 130 ft. below the surface. The shaft was retimbered, the headframe rebuilt, and a new hoist installed. They receive compressed air from the Teller County air lines.

▶ The air-line from the 30th level of the Portland mine to the winze level and the tunnel has been completed, and sinking started. Nel Salisbury, superintendent, states that the 30th level is completely dry, and clean-up work nearly completed. A pipe-line will be put into the winze to carry the water from the level to the tunnel, which will allow the men to use the manway without interference from water.

▶ Harrison Cobb, leasing from the Ingram Mines, Inc. at Salina, is mining new ore opened up by old-timers as early as 1875. This ore, too low grade to ship in the early days, is proving profitable and Mr. Cobb is shipping about 40 percent newly mined ore and 60 percent stope-fill and dump ore. The 500-ton output per month is trucked to the Golden Cycle mill, at Colorado Springs. A recent survey shows some three year's or more production in sight.

▶ John A. Law has transferred his scene of operations from Taylor Park to south of Iola, in the Spencer-Vulcan area. He states that the copper outlook in this section is promising. It will be remembered that Anaconda produced copper near Spencer during the last World War.

▶ The Curnow Transportation Co., Idaho Springs, has worked with Winter-Weiss Co. to solve the problem of keeping ores and concentrates from freezing during transportation from the mines and mills of the Clear Creek section to the smelter at Leadville. This haul is 80 miles over a mountain pass 12,000 ft. in elevation. Heat from the truck's engine is the solution. Winter-Weiss Co. welded a strip of iron to the floor and interior sides of the body, making an airtight channel around the bottom. The exhaust from the engine was piped into the channel and furnishes enough heat to bring loaded trucks to the smelter unfrozen.

Victor, Colo., in the Cripple Creek district, and the south slope of Battle Mountain. On the skyline in the center is the Portland mine and, to the left of this, the Ajax

▶ The new Carlton tunnel at Cripple Creek is now flowing at a rate of about 6,000 g.p.m. The maximum flow was 100,000 g.p.m. The water level at the Cresson shaft has been lowered over 250 ft. since the middle of February 1941. The 19th level, which is 250 ft. below the old Roosevelt tunnel, is dry. The rate of drainage from the Cresson was quite rapid at first, but has now slowed down, and it will be a number of months before the 20th level, which is 123 ft. below the 19th level, is unwatered. For this reason it is necessary for the Cresson to drive the 4,000-ft. lateral from the main Carlton tunnel to the Cresson ground. Approximately two-thirds of this 4,000 ft. is through ground owned by the United Gold Mines Co. The remaining distance will be through Cresson ground. This work will be started as soon as the Portland shaft is completed to the Roosevelt tunnel level. A. H. Bebee is general manager.

▶ The Rico Argentine Mining Co. has purchased the joint holdings of the International and Pelleyre companies, over 200 claims. This company operates a 135-ton flotation mill. Most of the recently acquired properties are on Newman Hill and run under Rico Townsite, tying in with the extensive Argentine holdings west of the Dolores River. Seventeen proved lead-zinc beds seam Newman Hill, and they have in past years produced more than $10,000,000 worth of ore. The Shamrock, on the west side of the river, was the first of the acquired properties to receive attention. It had been closed for fifteen years.

▶ The concrete piers and wall for the crushing and grinding sections of the new mill of Boulder Tungsten Mills, Inc., on Hugo ranch, have been completed, and the timber structure is in course of erection.

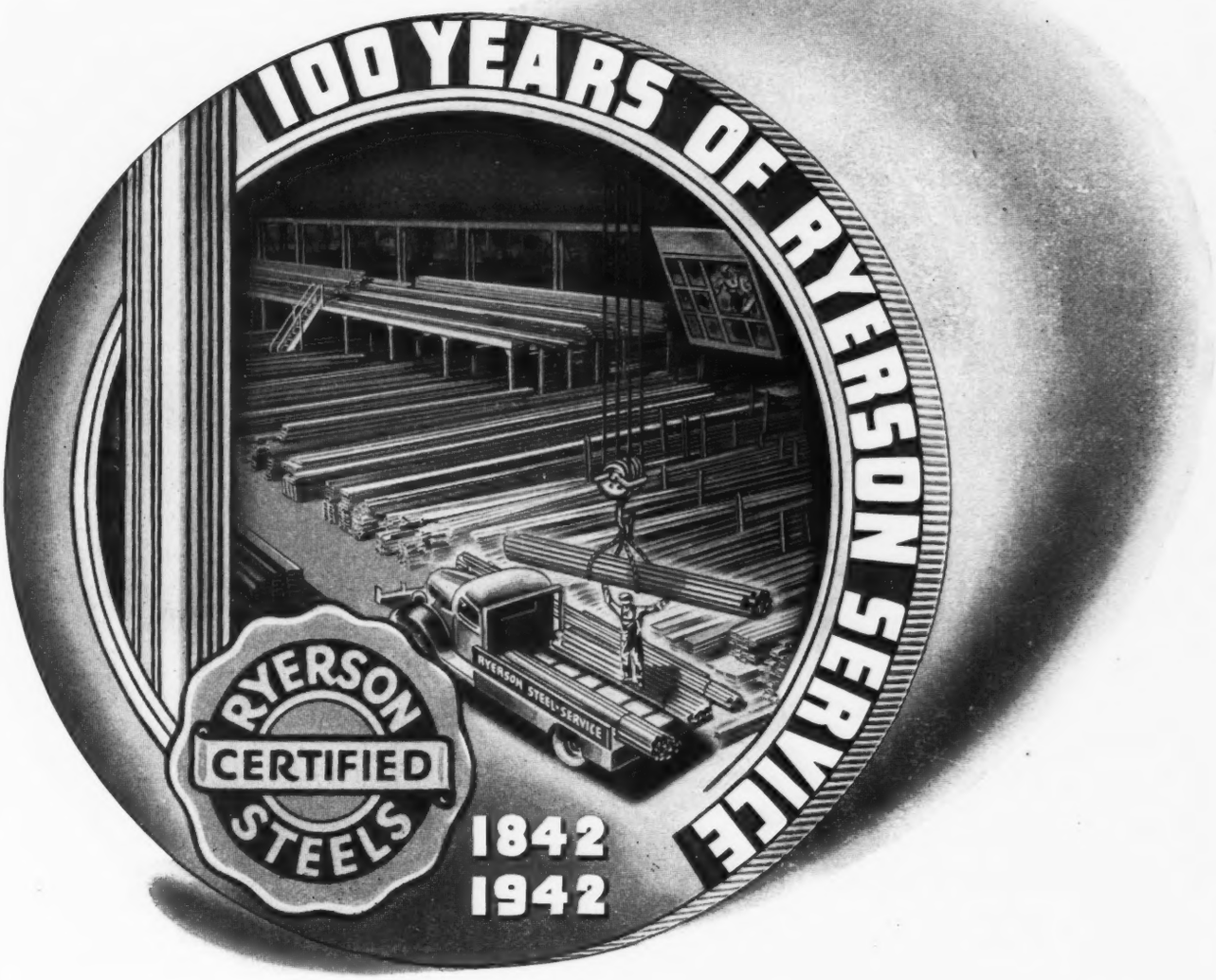
▶ The St. Louis Smelting & Refining Co. a large former operator in the Rico district, is getting ready to resume operations. Prior to the close-down in 1939 the company completed a development and exploratory program, including the driving of about 2,000 ft. of drifts and crosscuts. A 575-ft. three-compartment raise was put up, which connects the main St. Louis level with the Iron Springs group above.

▶ New machinery has been hauled to the Ben Harrison Croesus mine, adjoining the famous Lamartine property. It will be operated by George Calloway, Rovert Calvert, and associates, backed by Denver business men. This property was last operated by the late W. E. Passmore. Mr. Calloway states that it will probably be the middle of April before operations can get under way. Meanwhile the shaft will be retimbered and some buildings erected.

▶ It has been officially confirmed that American Smelting & Refining Co. has leased the old Malachite mine, near Starbuck, and will soon begin diamond drilling the 800-acre property to determine the extent of the copper deposit. A lease based on a royalty basis has been signed with the Colorado Kansas Syndicate, owners of the property. Resident manager J. Fred Johnson, of the American Smelting & Refining Co., is hopeful that a large amount of low-grade copper ore will be made available. The Malachite property is off the Bear Creek highway between Starbuck and Mt. Vernon canyon.

▶ The U. S. Geological Survey has established offices in Denver, and will superintend diamond-drilling operations for the government in the Boulder County tungsten belt. Tungsten operators signed up for this service several months ago. Among the first properties to be drilled are the Wolf Tongue mines north of Nederland and the Thomas Walsh holdings.

▶ General manager Alex McLallan of the Yacolo Mines, near Boulder, has been carrying on a development campaign



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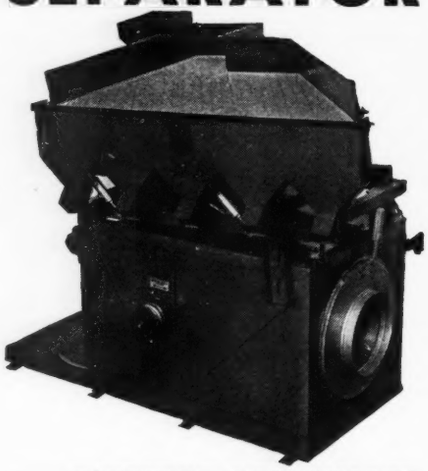

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▶COLORADO

and has struck pockets of good ore. Work on this extension of the Slide vein started May 1941. The property is owned by business interests in Washington State and William E. Brewster is president.

▶ The machinery for the 50-ton flotation mill at Brown's Canyon, near Salida, has been received and is being installed. General Manager Cooper Shapley states that the mill will handle the fluorspar of the American Fluorspar Co., and produce a product of acid and ceramic grades.

▶ W. D. Murdie, superintendent of the Carter Mines, at Ohio City, near Gunnison, has finished another successful year. The Carter mine again led producers in the Gold Brick district. This property has been owned and operated by Carroll W. Carter since 1899, when he and his two brothers drove the two-mile tunnel to develop the veins worked from the surface. The upper workings are connected with this tunnel by a 1,200-ft. four-compartment raise. Ventilation is so strong as to permit the operation of a gasoline locomotive for main level haulage.

ARIZONA

Base-Metal Mining on Increase Throughout State

Phelps Dodge Corporation expects to reach full production about mid-year — Mica shipped from Ajo to Los Angeles for processing

▶ A report by I. M. George, chairman of the Mohave County division, industrial resources and production, of the Arizona Civilian Defense Coordinating Council, shows that in the Cerbat mountain area there is now being shipped 2,000 tons of lead and zinc concentrates monthly and that there are approximately 60 other properties producing or capable of producing tonnages of lead-zinc ores. This information is compiled in expectation of obtaining federal aid in increasing the production of strategic minerals in this area.

▶ The Davenport Mining & Milling Co. is operating its custom mill at full capacity and shipping an average of 200 tons of lead and zinc concentrates weekly. The company is acquiring other properties, from which shipments to the mill will be made, assuring steady production. Ogden L. Chase, of Las Vegas, Nev., is general manager of the company's Mohave County operations, which include development of the copper deposits in the Emerald Isle group of claims near the mouth of the canyon leading into the Mineral Park area of the Cerbat Mountains 15 miles northerly from Kingman.

▶ The San Antonio mine, in the Old Hat district, near Oracle, is shipping good-grade silver ore to the smelter. A. M. Neal, of Oracle, Ariz., is managing the operations.

▶ The Castle Dome group of claims, owned by Arthur Haack and Eliza De Luce, of Yuma, has been leased to George and Kenneth Holmes. The property is about 45 miles northeast of Yuma. Values are in lead and silver. The new operators plan the erection of a 150-ton milling plant about 8 miles from the mines where water can be developed. The old dumps on the properties will be treated at the mill while ore underground is being blocked out.

▶ Iron King Mining Co., at Humboldt, is adding a 3x9-ft. Denver ball mill to its present plant, which is expected to step up the daily production from 250 to 300 tons. Its new shaft is now down to the 500-ft level. The company expects to increase production by more than 50 percent over 1941. Its payroll carries about 95 men. The values are in gold, silver, lead and zinc. H. F. Mills, of Humboldt, is manager.

▶ The Gold Bar Mining Co., operating the Allison group of claims in the Baboquivari district within the Papago Indian reservation, kept its mill in steady operation during 1941 and is expecting to increase production throughout 1942. Most of the mining is done by the Indians. L. M. Vreeland, of Tucson, Ariz., is manager of the property. Robert Gammell is general superintendent.

▶ The Tennessee-Schuykill mine, at Chloride, in Mohave County, is making regular shipments of six and seven carloads of zinc and lead concentrates weekly to the smelters. A very close selective flotation product is made in its milling operations. The lead concentrates go to El Paso and the zinc concentrates to Amarillo, Tex. Jacob Shoder is manager of the company.

▶ R. P. M. Davis is still operating the mill at the C. O. D. mine, 12 miles north of Kingman, on dump material and is shipping concentrates to the smelters. Developments underground are blocking out orebodies to feed the mill when the dumps have been exhausted.

▶ The American Smelting & Refining Co. is producing about 30 tons of concentrates daily at the old Trench mine, near Patagonia. The lead and zinc contents are about equal. T. A. Sneddon is superintendent of the mine and milling operations.

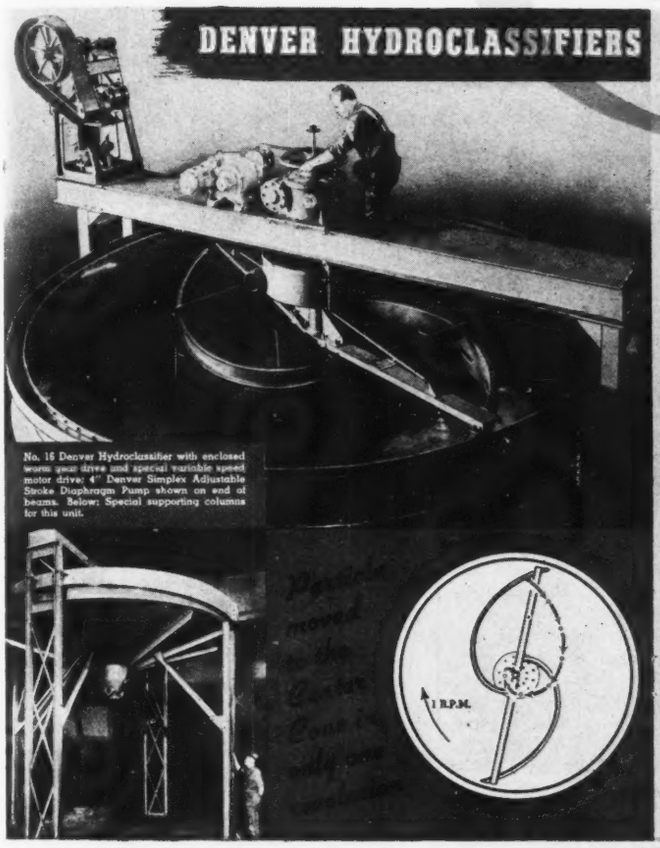
▶ The Control Mines, Inc., at Oracle are employing about 50 men. Shipments of copper ore are being made to the Hayden smelter. The 100-ton flotation plant is treating the ores under the direction of R. W. Adams. The yield for 1941 is reported at 1,279,000 lb. of copper.

▶ The E. Brock Co., of Welton, Ariz., is working the Casper Smith mines, 18 miles south of Wellton. Dump sampling shows considerable wolframite and some beryllium. A process is being worked out for efficient treatment.

▶ Shipments are being made from the Mohawk barium mine, 70 miles east of Yuma. Three to five cars a week are scheduled for market. C. R. Allen, of San Jose, Calif., is leasing the property from Ike Renner, the owner. Allen owns the Lodi barium claim near Bouse.

▶ The Desert Queen mine, southwest of Ajo, has shipped five tons of mica to Los Angeles, Calif., for processing. The mine is owned by R. L. Ballesteros, of

END YOUR FINE SIZING PROBLEMS



No. 16 Denver Hydroclassifier with enclosed worm gear drive and special variable speed motor drive; 4" Denver Simplex Adjustable Stroke Diaphragm Pump shown on end of beams. Below: Special supporting columns for this unit.

DENVER HYDROCLASSIFIERS

are solving the most difficult fine sizing and desliming problems by combining high metallurgical efficiency in a rugged, well-built machine to accurately fulfill the [illegible] conditions required. A [illegible] can now be made in the 100 mesh range and finer. This fine separation requires considerable classification area per ton as well as minimum agitation and accurate control.

New processes in the flotation, cyanidation, chemical, and industrial field are now opened up by this new machine. Definite applications include elimination of slime from breaker sludge in the anthracite field . . . in ball mill classifier circuits where there is an extremely fine grind and slime separation is required . . . in regrinding and desliming circuits, and in many leaching methods where a slime-free product is necessary.

OPERATION

The feed is brought into the center feed-well, and distributed in a quiet zone, the sand or coarser product settles evenly on the sloping bottom and the fine sized product overflows the circular rim into the launder. The slowly rotating spiral rakes continuously convey the settled material to the center cone where water is added under a perforated plate to displace the slimes from the granular solids before they are removed from the unit. This feature assists in obtaining a slime-free sand discharge.

To carefully regulate the exacting separation required especially on the extremely fine sizes, the Denver Hydroclassifier makes this possible by:

1—Ease of changing the speed of the rotating rakes.

2—Rakes which can be raised or lowered by the protected internal shaft lifting device.

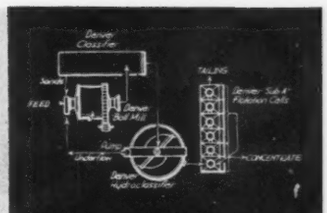
3—Control of the solution or water inlet and the rate of discharge; accurate separation is secured. Normally, just sufficient solution is added to the cone to displace the solution removed with the solids through the underflow.

Simplicity of operation and design makes the results constant and accurate.

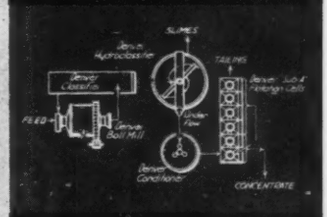
SUPERSTRUCTURE

The superstructure, for supporting the worm gear drive and rakes, consists of heavy steel members with top flanges which are tied together by

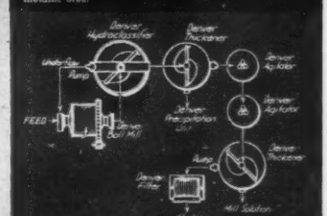
[2]



DENVER HYDROCLASSIFIER IN THE BALL MILL CIRCUIT.
Recommended for 100 mesh and finer grind, and where return of critical size particles to the grinding mill is vital.



DENVER HYDROCLASSIFIER IN DESLIMING OPERATION
Elimination of slime from flotation feed is often necessary for improved metallurgical results and to reduce reagent costs. This applies particularly to the treatment of non-metallic ores.



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Fine grinding of gold-bearing pyrite concentrates is assured when a Denver Hydroclassifier is incorporated in the

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can well be the answer to your fine sizing and desliming problems. This is only one of several flowsheets taken from successful operating mills which are shown in this new bulletin. Accurate separations can now be made in the 100-mesh range and finer.

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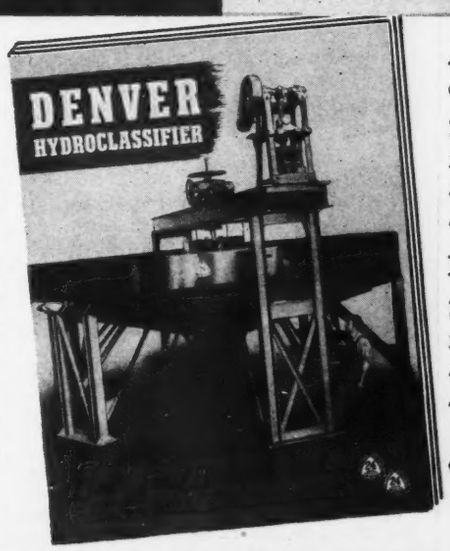

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2. ***Grinding mill circuits.***
3. ***Removing slimes for leaching.***
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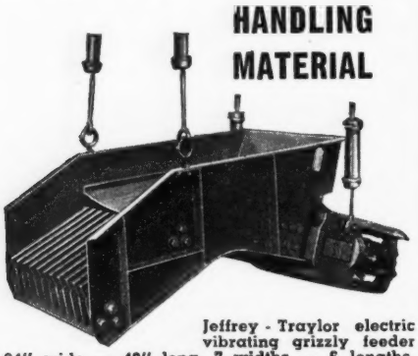
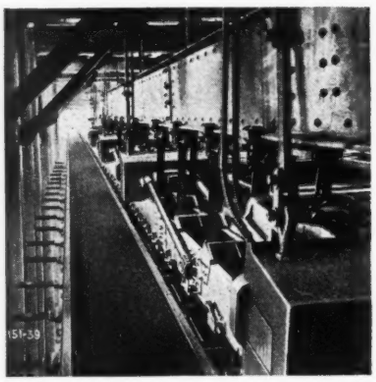
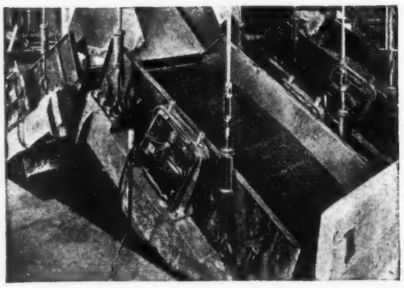


Jeffrey - Traylor electric vibrating grizzly feeder 24" wide — 48" long. 7 widths — 6 lengths. Handles 3 ft. cubes to dust.

Jeffrey-Traylor grizzly feeder discharging 250 tons per hour to picking belt conveyor. Separation at 3" and fines are by-passed crusher. Also open or totally enclosed pan feeders.



Jeffrey-Traylor reverberatory charging vibrating conveyor equipped with 22 Quick-acting discharge gates — permits rapid charging of furnace. No mechanical wearing parts.



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▸ARIZONA

Tempe, Ariz., and is under lease to H. T. Lyons, of Ajo.

▶ Keith Knight, of Quijotoa, is operating the Five Metals mine, northwest of that place. The ledge is large and hand sorting is resorted to for a shipping product. The remainder of the ore is held for milling purposes. Values are in lead, silver and gold.

▶ The Dinner Pail group of six claims owned by Cecil Martin, Lordsburg, N. M., and situated 30 miles northwest of Hyder in the Palomas district of Yuma County, is under lease to H. W. Hess.

▶ The Fortuna gold mine, southeast of Yuma, has been leased to Burton Brothers, Rosamond, Calif., who have been doing considerable development work. Equipment on the property includes a 40-ton cyanidation and amalgamation plant. Elan Mining Co., of San Francisco, is owner of the property. William B. Haitland, of Yuma, is superintendent of the operations.

▶ Patagonia Metal Mills, Inc., has a contract with the Metals Reserve Co. and is shipping concentrates to the Federal stockpile at Phoenix. The mill has a capacity of 50 tons daily and is equipped with jigs and tables. A new flowsheet is being put into use. The ore at present is taken from the San Fernando mine, owned by Herman Bender, of Patagonia, and under lease to the Santa Cruz Manganese Mine, Inc., a company headed by the same officials as the contractors. Del Lord, of Patagonia, is president of the companies.

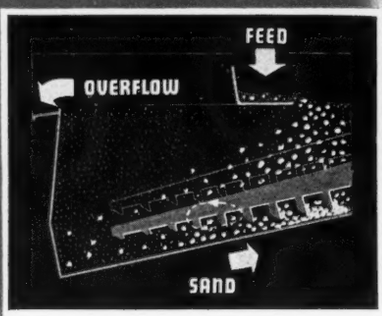
▶ Phelps Dodge Corp., at Morenci, expects that full production will be under way by the middle of the present year. Full production means that 25,000 tons of low-grade copper ore will be put through the mill daily. The first unit of the mill was put in operation in January of this year. Gilbert C. Davis is manager of the Morenci project.

▶ The Morris group of ten claims in Santa Cruz county is under lease and option to David L. Roscoe, 1540 Cardiff Ave., Los Angeles. The mine now has some 1200 ft. of underground workings, which are being rehabilitated preparatory to shipping of ore. Values are in copper, lead, and silver.

Zinc Institute Meets

THE twenty-fourth annual meeting of the American Zinc Institute will be held on Monday and Tuesday, April 20 and 21, at the Chase Hotel, St. Louis, Mo. Washington agencies concerned in the war effort have welcomed the opportunity to participate in this meeting. They expect to send representatives to St. Louis to discuss and advise on various phases of the industry's part in the Victory Program. Among the important subjects to be covered are slab-zinc production and distribution, mine production, quotas, and priorities. A comparative study of the world's supply of strategic metals is also scheduled. Special speakers will discuss current trends in national policy toward taxation, labor, and other vital problems.

CONTROLLED AGITATION



Controlled Agitation, an exclusive Dorr principle, is the opposite of "quiescent pool" classification, where the point of separation is governed solely by the slope of the tank and the dilution of the pulp.

Controlled Agitation, provided by Dorr's patented Tapered Rake Blades, may be mild or intense, depending upon the separation. It supplements the two other minor factors—slope and dilution—to give a flexibility and control unequaled elsewhere.

Pulsations set up in the pulp pool cause the particles to stratify horizontally—the fines at the top, the coarse at the bottom. A jigging action imparted to the sand bed aids in the release of entrained undersize.

Result: less oversize in the overflow, less undersize in the sand, less overgrinding in the ball mill. In short, better metallurgy because of a better prepared feed to flotation and cyanidation.

★

This advertisement is one of the following series of six on "Better Metallurgy Through Better Classification," covering some often overlooked factors in classification practice:

1. Controlled Agitation.
2. Mechanical Principles and Operating Costs.
3. Capacity per foot of width.
4. Tank Slope and the All-Gravity Closed Circuit.
5. Starting up after a power outage.
6. Flexibility under changing conditions.

Reprints of previous ads in this series will gladly be sent you on request.

ONE OF A SERIES ON BETTER METALLURGY THROUGH BETTER CLASSIFICATION

WHY CONTROLLED AGITATION IN DORR CLASSIFIERS

VISITOR

What do they mean when they talk of Dorr's exclusive principle of Controlled Agitation in the pulp pool?

MILL "SUPER"

Controlled Agitation is a condition set up in the pool by Dorr's reciprocating rakes. It may be mild or intense, depending upon the separation you are after.

*

Yes, but aren't slope and dilution the main control factors? Aren't they more important than this agitation effect?

No, you've got it twisted. It's just the other way around.

Controlled Agitation is the major factor—slope and dilution minor ones. It takes all three to give Flexibility and full control over the operating range.

*

Hold on a minute. Just what is the effect of this Controlled Agitation on the pulp in the Classifier?

There are two effects, not one, and both are equally important.

In the first place, the pulsations set up in the pool cause the particles to segregate in zones—fines at the top close to the overflow, sands at the bottom close to the rakes.

Furthermore, the rakes set up a jigging action in the sand bed. This jigging, once for each bite of the rakes, aids in releasing entrained undersize that otherwise would go back to the ball mill.

*

I see. I'm beginning to get it now.

But just what does all this mean to me in terms of my own costs and my own metallurgy?

Controlled Agitation means plenty. Less oversize in your overflow, less undersize in your sand, less uneconomical overgrinding and sliming in your ball mill.

You win on two counts. Count No. 1: more grinding because of less cushioning slimes in your ball mill. Count No. 2: better metallurgy—a few percent more extraction, a few hundredths of a percent better tailing—because of a better prepared feed to flotation or cyanidation.

*

Thanks a lot. Looks to me as though Dorr has something there that no one else has.

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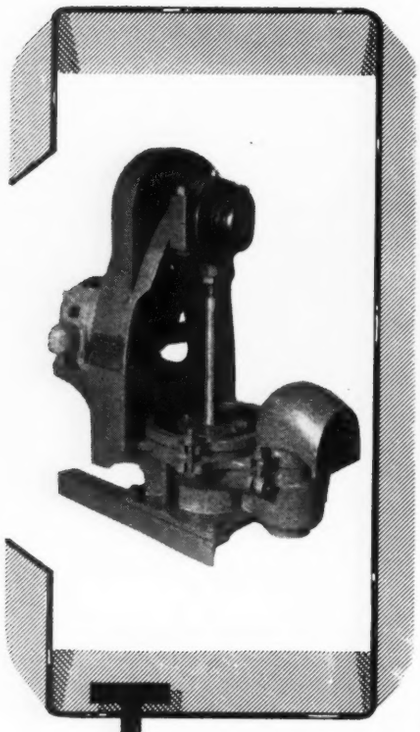

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WEMCO

Diaphragm Pump with the eccentric stroke regulator controls densities and capacity while the pump is in operation.

Variations of capacity from zero to maximum, and back again, or at any point between, are made in 30 seconds. Simply turn the handwheel, watch the discharge and set the stroke at the proper capacity and density.

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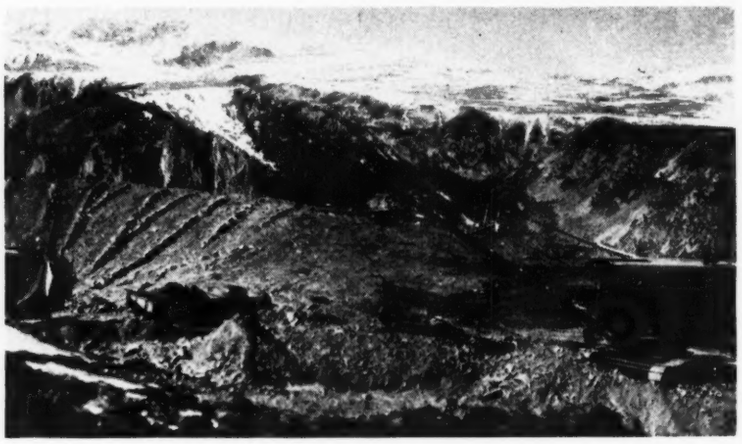

Chrome-ore mining operations of United States Vanadium Corporation in the Red Lodge district of Montana

ARKANSAS

Unusual Activity In Manganese Field

Bad weather curtailed February production, but March will probably exceed the average—More than 40 prospect shafts being sunk in the district

▶ February production of manganese ore in the Batesville-Cushman manganese field was reduced sharply by bad weather. Only 395 tons was shipped, against a monthly average of 600 tons. March and April production are climbing and will probably run over the average.

▶ Manganese Incorporated, which started operations in south Stone County, near Mountain View, has made its first shipment of manganese carbonate to the Electro Manganese Corp., at Knoxville, Tenn. The company is operating on a carbonate formation occurring in the St. Joe limestone which starts in south Stone County and runs through the northwest part of the State. It is a chocolate-colored marble. Recent investigations show that that part of the formation in south Stone County, which is from 4 to 7½ ft. thick, is impregnated with manganese ranging from 8 to 28 percent. Starting on the Wolford Land across the White River from Williamson this vein can be traced for 3 miles. Outcrops show in places over an area approximately 10 miles long and 4 miles wide. Though it is low grade it is particularly adapted to the electrolytic process of reduction. It carries less than 1 percent phosphorus and about 1 percent silica.

▶ The Arkansas Manganese Co. has installed a new belt conveyor car loader on its ore yard in Cushman, and loading with the new equipment is greatly expedited.

▶ Forty new prospect shafts are now being sunk on the Walter H. Denison properties. This is the largest number of shafts ever sunk at one time in the field. It is speculative as to how many will become producers.

▶ Elmer Webb, of Mountain View, and associates of Springfield, Mo., are sinking six prospect drill holes on a mineralized fault in south Stone County. They are seeking oxide manganese. The fault extends back of a cave that has produced some good oxide ore.

▶ Fred Livingston and Preston Grace, of Batesville, Ark., are sinking two new prospect shafts on their property on Lafferty Creek. They already have three shafts in high-grade manganese ore on this tract.

▶ The Northwest Arkansas Mining Co., composed of former Tri-State operators, has taken over the Brewer, Kilgore, and House properties, in the Ponca district, in Newton County. In an interview with S. C. Byrd he stated that they would sink a new shaft on the Brewer to a depth of 135 ft. or deeper. They expect to erect a modern 200-ton concentrating plant as soon as they open up enough faces to supply crude ore for the plant.

▶ Hurricane Mining Co., operating the Campbell zinc mine, in the St. Joe district, in Searcy County, is installing new pumps and a compressor. It is expected that with this new equipment the production of the mine will be doubled.

▶ The new mill at the Edith mine, in the Rush Camp, in Marion County, has been completed and is in operation. The company is headed by C. S. Freeburne, of Wichita, Kansas. Bill Maxey, pioneer mining man of the Rush Camp, is foreman. The Edith mine produces a high-grade carbonate zinc ore.

▶ John Dirst, pioneer zinc-mine operator in the north Arkansas field, in conjunction with a Tri-State operator, is now working out plans to put the La Rue, Lonnie Boy, and Silver Hollow mines in operation. They are all in the Rush camp.

▶ Active mining of domestic bauxite has been commenced by a subsidiary of the Reynolds Metals Co. The ore will be shipped to the company's Alabama aluminum plant. Original shipments of bauxite for the Reynolds plant came from the Netherlands East Indies. During the past fall the Reynolds company made contracts for bauxite from Suri-

nam, Netherlands colony in South America. Using bauxite from domestic sources releases ships that otherwise would be required to bring this mineral across the sea, and in some degree also cuts down the rail haul required to bring the ore to the plant.

▶ Roy Warren, manager of the Arkansas Smelting Co., Van Buren, Ark., announced some time ago that the company would reduce operations and production by 25 percent immediately to cut fuel and labor costs. Responsible for the reduced operation is an increased rate for natural gas that went into effect Dec. 31, 1941. The price ceiling on zinc and the increased gas rate wiped out the smelting company's margin of profit. According to A. B. Harper, president of the gas company, the increased rate was ordered by the Arkansas Utilities Commission. In an appeal to the Pulaski Circuit Court, a stay has been requested by the Arkansas Smelter Co. Saying the higher gas rate was "unjust, unwarranted, and discriminatory," the smelter company alleged the new rate for natural gas requires the smelter to pay rates higher "than any other industrial consumer using a comparable amount of gas." The December 31, 1941, order authorized the pipe line company to increase the rate from 10.2¢ to not less that 12¢ per 1,000 cu.ft. The new rate calls for 15¢ on the first 3,000 cu.ft.; 13¢ on the next 27,000 cu.ft.; 12¢ on the next 30,000 cu.ft.; and 11¢ on all over 60,000 cu.ft.

IRON-COUNTRY

Preparing for Huge Ore Shipments This Spring

Expected that 92,000,000 tons of iron ore will move down the Lakes in 1942 season —New steam shovels and other equipment being ordered

▶ Consumption of iron ore by the Lower Lake furnaces is now running better than 7,000,000 tons per month. On a yearly basis this would amount to about 86,000,000 tons. Stocks of ore at Lower Lake docks and furnaces are fast dwindling, and the opening of the navigation has come none too soon. The first boats, as expected, arrived at the head of the Lakes on March 25 and 26, the earliest opening of navigation in the history of the Great Lakes region. There was no reason why the boats should not have arrived at this time, as every effort had been made to assist them in getting through the ice that was still in evidence in the rivers, bays, and harbors. An early opening such as this is practically essential to move the desired 92,000,000 tons of iron ore required for the Victory program. An average of 10,000,000 tons monthly will have to be moved throughout the season up to Dec. 1. This tonnage also represents an increase of 12,000,000 tons over shipments during the 1941 season.

▶ The Oliver Iron Mining Co. has started sinking a five-compartment shaft at the Fraser mine, at Chisholm, Minn. The Fraser is one of the larger open pits on the Mesaba range, and the sinking of

Twice the Mileage

Results from Application of Amsco Economy Hardface . . . . . .

Increasing the mileage is the need of the hour, whether it is in tires on your car, sprockets on your tractor or other equipment wearing parts. It is our job, yours and mine, to *Increase The Mileage* and to aid the war effort by conserving existing equipment and reducing production of parts that divert essential materials. Amsco's Welding Products have conservation and reclamation as their objective. We present a real "find" in conservation which may prove helpful in "Increasing Your Mileage."

The crawler tractor sprocket shown has already been built up three times with Amsco Economy Hardface which again has lived up to its name. *Each rebuilding gave nearly twice the service* of a new sprocket under the severe conditions found in construction grading. That adds up to six times the mileage given by a new part at far less than six times the cost — and further reclamation is possible. That, you will agree, is conservation.

How To Do It

Remove all laminated or mushroomed metal from the worn sprocket teeth; provide a metal template which will indicate the contour of the teeth on a new sprocket, including enough teeth to maintain uniform pitch. Build up both sides of the teeth with a high carbon or low alloy electrode to within 1/8" of the template size, and over this deposit apply one layer of Amsco Economy Hardface electrodes to fit the template. This gives the hard, abrasion-resistant surface necessary for wear resistance and, because Economy Hardface applies smoothly, the proper tooth contour can be acquired without grinding or other finishing operations. The Economy Hardface deposit has the ability to polish in service and on this account galling and seizing are reduced to a minimum, and service increased to a maximum.

Send for Bulletin No. 941-W

Points the way to "increased mileage" for every industry using heavy-duty ferrous equipment parts which are subjected to shocks, heavy loads and abrasion. Suggests how to forestall wear by hard-facing new parts and how to reclaim worn parts by restoration with Amsco build-up materials.

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OF THE AMERICAN BRAKE SHOE & FOUNDRY CO.
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Chromium-Nickel Alloy Castings for heat and corrosion resistance.
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NON-SCORING

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saves shafts, rods, stems

Palmetto Self-Lubricated Packing makes a hit with plant engineers and maintenance men because it saves them repacking time, labor and expense.

Pumps, valves, and other equipment give longer, more trouble-free service when packed with Palmetto, because its abundant graphite lubricant protects shafts, rods and stems from scoring.

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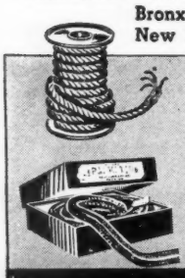

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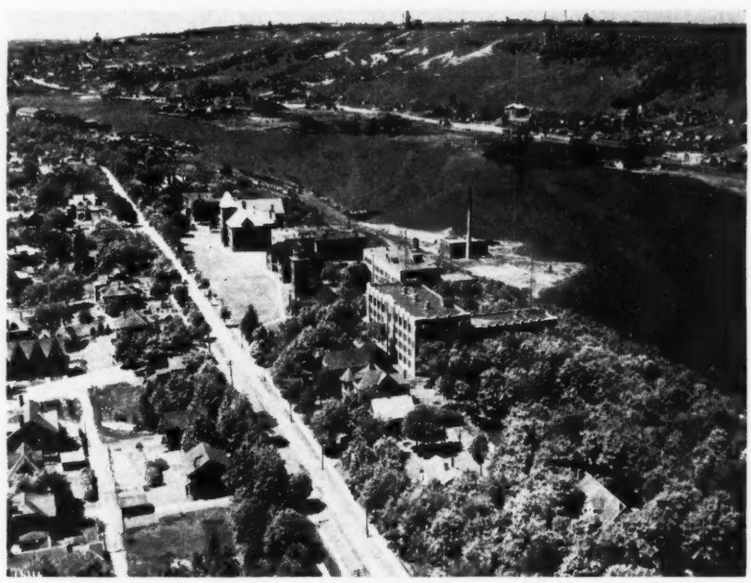
KLERO *for foods, etc.* PALMETTO SUPERSHEAT
PACKINGS

9 out of 10 who try them, buy them



Campus of the Michigan College Mining and Technology at Houghton, in the Copper Country

▶IRON COUNTRY

such a large shaft appears to be an anomaly. A water problem, however, has necessitated this shaft. A second reason is that the depth of the orebody will eventually force hoisting the ore through the shaft. The shaft is to be 600 ft. deep with outside dimensions of 11x18 ft. It will have steel sets and steel lath lining. Later a steel headframe, hoist, compressor house, change house, repair shop, and office building will be constructed.

▶Orders for new equipment are being made in large quantities, and several operations are encountering difficulty in obtaining delivery on their orders. The Oliver Iron Mining Co. has recently ordered seven new shovels for service in its large pits. The shovels ordered were one Bucyrus-Erie 170-B, four Bucyrus-Erie 120-B with 5-yd. dippers, and two Marion, Type 492, with 3-yd. dippers. This same company is now receiving delivery on an order of 49 trucks ordered last year and has also placed an order for 12 additional Euclid, diesel-driven trucks.

MICHIGAN

Extensive Exploration Programs Under Way

Through purchase, option, and lease, Calumet & Hecla is acquiring control of large area—Company's foundry machine shop in war work

▶Calumet & Hecla Consolidated Copper Co. is making encouraging progress in its efforts to perpetuate its life, not only as a producer of copper but of other metals. Land taken over during the past year, through purchase, option, lease, or exchange, has given the company control of an extensive, consolidated area, all mineral bearing, extending from Ahmeek to the Cliff property in Keweenaw County. This has made possible not only a more northerly investigation of the Kearsarge lode but has put Calumet & Hecla in position to explore other amygdaloids and fissure veins through underground openings, diamond drilling, or trenching.

▶A favorable option agreement with the Peninsula Copper Co., which owns the former Seneca lands, 2,811 acres, makes possible an extensive exploratory program from Ahmeek Nos. 3 and 4 shafts. It is likely, too, that the Seneca No. 1 shaft area will be unwatered and favorable ground stoped. A high-grade oreshoot encountered on the 33d and 38th levels from Ahmeek, No. 4, is believed to extend both upward and to greater depth. The 43d level from No. 3 has latterly been in lode of fair grade, possibly the downward extension of the rich shoot. Development will be continued.

▶The purchase of the Ojibway lands, 3,000 acres, north of and contiguous to the Peninsula property, will permit investigation of certain promising amygdaloids. Similar work will be done on the lands of the Peninsula company.

▶Calumet & Hecla is making available any excess foundry- and machine-shop capacity the company may have from time to time for armament production. The company is already engaged in turning out 7,400-lb. engine bases for Chrysler armament plants and 28,000-lb. bed plates for test stands for Packard marine engines. The company also has agreed to do the machining on several castings for tank turrets for the Rock Island arsenal. The company is more than willing to further the defense effort if by so doing its own production of refined copper is not retarded.

▶Development work is proceeding in property which includes what was formerly the Douglass, Concord, Arcadian, New Arcadian, and New Baltic mines. This tract is owned by a local group.

with Prof. W. A. Seaman, of Michigan Tech., in charge of exploration. An adit is being driven near the south end of the property which extends five miles northeasterly along the strike of copper-bearing formations. The adit workings consist of about 3,400 ft. of drifts and crosscuts exposing ten lodes, of which five are copper bearing. Two thousand feet of drifting has been done along the two best looking lodes. It is the present intention to stope at least 1,000 tons of ore, and which it is hoped to run a mill test. No pumping or hoisting are necessary at present.

NEVADA

Mining Men, at Reno, Protest Recent Priority Ruling

Dr. W. A. Nelson urges precious metal producers to get into something "essential". New finds of tungsten, one of tin

▶ A meeting held at the University of Nevada, in Reno, on March 12, to discuss a program for increasing production of the strategic metals, presented by Oscar L. Chapman, Second Assistant Secretary of the Interior, resolved itself into a concert of protest against WPB priority rulings affecting those mines whose product, in dollar value, exceeds 30 percent in gold or silver. Defending the withdrawal of former ratings and stressing the present scarcity of mine equipment, Dr. Wilbur A. Nelson, administrator of the WPB mining branch, urged producers of the precious metals to "get into some industry that is essential." Speakers included the governors of Nevada, Utah, Idaho, Colorado, and Arizona, Nevada's two U. S. Senators and Congressman, with numbers of Western leaders in the industry. Expressions of mining men since this meeting and the one of March 14 at Denver indicate they have derived scant comfort from promises that the 30 percent ruling will not be too rigidly enforced.

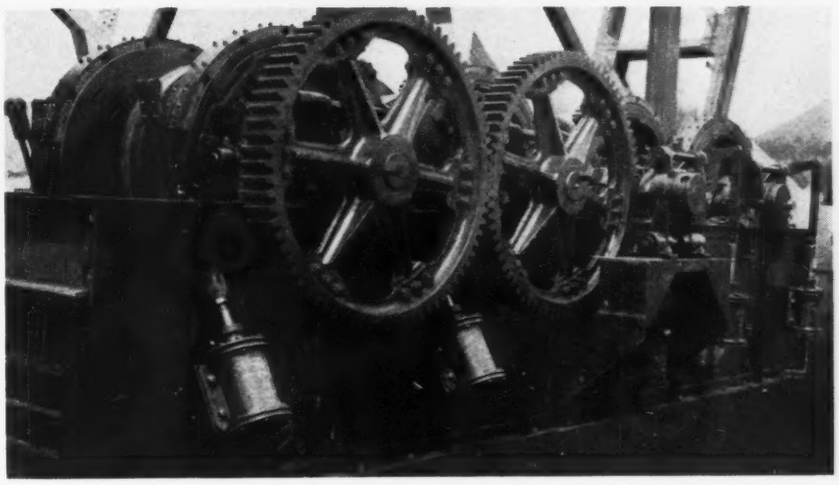
▶ Construction of the manganese concentrator for M. A. Hanna's Manganese Ore Co. is now under way in the Las Vegas district.

▶ Installation of equipment to recover tungsten in the 1,000-ton cyanide mill of Getchell mine has been under consideration. A scheelite zone, partly developed, lies a few hundred feet west of and parallel with the gold orebody supplying the mill and extends south along the Osgood range. Original plans for the mill, first designed to treat 600 tons per day of gold ore, provided for a tungsten plant within the large structure. The Getchell is now producing arsenic also in some quantity, a Cottrell precipitating unit having been provided.

▶ Concentrate from a small gravel-washing operation in the Rabbit Hole placer district in northern Pershing County, sent to the State laboratory of the Mackay School of Mines to be tested for mercury, was found to contain tin, as cassiterite.

▶ Scheelite has been found to be a component of gold ore of the Ashdown mine,

PARTS BY YUBA TO SPEED PRODUCTION OF METALS



Typical Yuba ladder hoist winch, air controlled.

Machinery and parts by Yuba are available to the mining industry producing strategically important metals. Dredge parts, bucket elevators, stacker conveyors, pumps, screens, bucket pins, winches, hoists and similar equipment by Yuba may help to increase your output of important metals.

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Looking north across Gabbs Valley, Nevada. Here a massive deposit of brucite is being mined by power shovel and trucked to crusher and loading bin at left

▶NEVADA

in northwestern Humboldt County, one of the first gold mines to be worked in northern Nevada. George Mathewson, of Winnemucca, holding a five-year lease, has been operating a 10-ton amalgamating mill. He is said to have test results indicating an average of over 1 percent tungsten and plans to equip the 100-ton Curley mill to treat the ore and old tailings.

▶A new cinnabar district is being brought into production with installation of a furnace at Kitten Springs, Pershing County, a few miles from the Relief or Antelope Springs district, one of the most productive of mercury in Nevada. C. N. Williamson, now of Reno, who has been manager for the McAdoo Mining Co. during the period in which it has been the State's largest producer of quicksilver, is installing equipment.

Protect Children from Blasting Caps

ALL USERS OF EXPLOSIVES are being asked to cooperate in the movement to protect children from the dangers of playing with blasting caps. Although warnings against allowing these caps to fall into the hands of children are contained in each box of caps, records show that many of them are left lying carelessly about. Those who use explosives can make themselves the most important factor in the movement to save children from injuries and sometimes death by making sure that the caps are carefully stored where boys and girls cannot get them. Accidents to children from playing with blasting caps decreased in 1941 compared with 1940. The desire this year is to eliminate these dangers as completely as possible. It is felt that this can be done if there is wholehearted cooperation on the part of all.

SOUTH DAKOTA

Manganese Resources Will Be Exploited

Extensive deposits of low-grade ore will be milled to yield concentrates suitable for mixing with high-grade products

▶South Dakota's almost unlimited manganese ore supply, often cited as an emergency source of the vital steel-making metal, will be given a chance to prove its worth. Plans announced by the War Production Board call for immediate construction of an $800,000 plant near Chamberlain, S. D., to supply about one-twelfth of the American steel industry's next year's requirement of 1,250,000 tons of manganese ore. The 16 percent South Dakota ore will be combined with ores containing as much as 60 percent manganese from Montana and Minnesota to give the 48 percent metallurgical grade. Plans call for mining and treating about five million tons of South Dakota ore a year, to yield about 300,000 tons of manganese nodules that lie loose in the black shale along the Missouri River in central South Dakota. The nodular manganese ore field near Chamberlain, according to surveys by the South Dakota Geological Survey and the United States Bureau of Mines, constitutes the largest reserve in the country, but its development has been consistently blocked by the high cost of processing. Construction of the new plant follows several months of experimental work on the ore at a pilot plant near Chamberlain and at processing plants at Salt Lake City, Utah, and Nashville, Tenn. Tests at the pilot plant, according to F. D. DeVaney, Bureau of Mines metallurgist in charge, have demonstrated that nodules can be successfully separated from the clay by screening, explosive-shattering, and kiln-drying processes. Such separation produces a concentrate containing from 16 to 17.5 percent manganese.

▶ The South Dakota manganese ore will be transported on barges on the Missouri River to St. Louis or other points for combination with the higher-grade ore, according to word received by Governor Harlan Bushfield of South Dakota. The presence of low-grade manganese ore in this area was first discovered in 1927 during investigations of proposed hydroelectric sites on the Missouri River. Several private investigations were conducted during the next two years, but difficulty of finding feasible methods of extraction prevented any development, although several processes were discovered during the ten years following the discovery. At the opening of the European war, the manganese deposits again attracted attention. As a part of a nation-wide program of re-examination of mineral resources, the South Dakota Geological Survey undertook a thorough study of the Missouri River deposits. The investigators estimated that the deposits contain from 850,000,000 to 5,000,000,000 tons of manganese, enough to supply the United States for generations, with at least 50,000,000 tons of nodules available for open-pit mining.

▶ South Dakota's two major gold mines hoisted 1,634,973 tons of ore during 1941, valued at $20,519,025, according to annual reports just issued by the companies. The Homestake Mining Company, of Lead, brought up 1,499,988 tons of ore with a value of $19,529,080, or $13.02 a ton. The average value per ton in 1940 was $13.26 and the total production was practically the same as in 1941. The State ore tax for last year amounted to $1,060,311. The Yates shaft was completed to the 4,100-ft. level by the close of the year except for some pipe lines and power cables.

▶ Production from the Trojan properties of the Bald Mountain Mining Co. last year amounted to 134,985 tons, valued at $989,945, or $7.33 a ton. The 1940 average per ton was $7.23. Besides continuing work in Lawrence County at Trojan, the company carried on development work at the Empire mines, acquired in January 1941 in Pennington County, near Hill City. C. E. Dawson is general manager and Herman P. Goodrich is mill superintendent of the 365-ton all-slime cyanide plant. Stewart Ferguson, of Trojan, is in charge of the Hill City work.

IDAHO

New Silver Producer Declares Initial Dividend

Approximately 7,000 men employed in mines of State—Coeur d'Alene companies pay the highest wage scale

▶ Coeur d'Alene Mines Corp., Idaho's newest silver producer, recently declared its first dividend for 1942, amounting to 5c. a share, totaling $144,751.95. Its initial dividend (8c.) was declared last December. The mine is opened to the 1,800-ft. level, but stoping has been confined to above the 1,400 level. Crosscuts from the 1,600 and 1,800 levels have opened the same high-grade silver orebody found higher up. A total of 87,672

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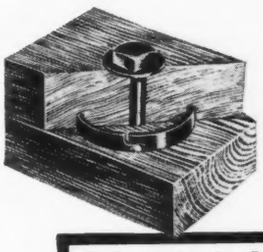

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dry tons was mined in 1941, averaging 16.77 oz. silver, 31.6 lb. of copper, and 18.9 lb. of antimony. Mill capacity was increased to 600 tons per day. Sinking will be resumed; 200 men are employed.

▶ Sherman Lead, at Burke, declared a dividend of 2c. a share, amounting to $73,500.

▶ Tamarack & Custer announced a profit of $59,051.26 above operating expenses for 1941. New development was carried down to the 1,800-ft. level. A crosscut connecting the Tamarack with the Sherman was completed. Revenue amounted to $868,220.28. About 150 men are employed.

▶ Jack Waite reported a gross income of $46,435.33 for 1941, an increase of $20,756. The mine is under American Smelting management, which expended $46,923.02 for new development, and 28,038 tons of ore was mined, mostly from new stopes in the upper workings, considered the richest lead ore in Idaho.

▶ Twenty-six placer mining operations and five lode mines in Clearwater County are credited with producing 3,417 oz. gold in 1941, valued at $119,595, according to Arthur Campbell, State Mine Inspector. Most of the placer operations use modern dredges.

▶ Silver Dollar has completed 300 ft. of new shaft work to the 1,700, where a crosscut is being driven to the vein, 500 ft. away. The collar is 1,000 ft. below surface, and actual shaft depth is 2,700 ft.

▶ Copper King, Mullan district, is completing the reopening of its lower tunnel in Deadman gulch. About 4,000 ft. of the main tunnel was opened last year, costing over $4,000.

▶ The Pope-Shenon copper mine, at Salmon, was reopened recently and has shipped its first concentrates. The 25-ton flotation plant will be enlarged.

▶ Lynch Pine Creek Mining Co., west of Kellogg, elected Herman Miller as president; George Turner, of Kennewick, Wash., vice president; Ray Yates, Kennewick, secretary-treasurer. It is developing the old Phil Lynch property and thinks it is within 50 ft. of the vein.

▶ Lone Pine Mining Co., Elmore County, plans to erect a mill. Three sulphide veins have been opened by a 1,200-ft. tunnel.

▶ Pine Creek Lead-Zinc, west of Kellogg, has leased the Little Pittsburgh mine and mill to Inar Norgaard and associates, of Kellogg, for three years. The leasers state there is enough high-grade zinc ore blocked out for steady operations under the premium price.

▶ Sunshine Consolidated has taken 211 tons of silver ore from its drift development on the 3,100-ft. level of the Sunshine Jewell shaft, giving a net return of $1,367. The ore milled averaged 19.37 oz. silver.

▶ Callahan Consolidated is stoping on the Patuxent vein, in the Sunset Peak district. The ore will go to the Silver Crescent mill.

▶ Golconda Lead has elected Judge A. H. Featherstone, of Wallace, president; Herman Marquardt, secretary; W. H. North, vice president; Ross Roundy, F. C. Keane, and Roy Nelson, directors.

▶ Coeur d'Alene mining companies are getting eight uses per bit out of detachable bits resharpened at the Bitco company's plant at Osburn. The saving made through the hot-milling methods used has lowered drilling cost. The plant sharpens 4,000 bits per day with 14 men employed. Branch plants have been opened at Helena, Mont., and at Cardin, Okla.

▶ Upward of 7,000 men are employed in Idaho's mining industry with 75 percent of the total working in mines of Coeur d'Alenes. The new wage scale follows: shift bosses, $8.50; hoistmen, $8.25; miners, $7.25; surface labor and unskilled workers, $6.25 to $7.

▶ Federal Mining & Smelting has ten men sinking a 200-ft. shaft at the General Mines property, west of Kellogg.

▶ Large reserves of tungsten ore have been discovered by the U. S. Geological Survey as the result of extensive diamond drilling at the Ima mine, at Patterson, according to Ben R. Tillery, Twin Falls, president. Present mill capacity will be doubled. Production for 1941 reached a peak between 800 and 900 tons of high-grade tungsten with 20,000 tons of byproduct lead-silver-zinc concentrates.

▶ Production at the Grunter mine, at Shoup, in Lemhi County, will be increased from 125 to 400 tons a day, according to Lawrence L. McLean, manager of Gold Producers, Inc., owner and operator. Unexpected discovery of a body of scheelite ore caused this increase.

TRI-STATE

Effect of Premium Prices Not Yet Known

Over-quota production will receive premium of $28.05 for zinc concentrates and $39.60 for lead — Old shafts being reopened—Some new drilling activity

▶ The stimulus of premium prices for new and above-quota production finds some new activity planned or under way throughout the Tri-State district. Nearly all operating companies in the field have received their quotas, with a "zero" quota established generally for the output of tailing plants. Most of the producers in line for premium payments seem satisfied with the system, but those not on the receiving end react adversely. What effect the subsidized program will have on the production of the field as a whole remains to be seen. Among complications that may arise are royalty settlements to land-owners, custom-mill tolls, and labor adjustments. At the beginning of March, the McColgin Ore Sales Agency, of Joplin, was appointed by Metals Reserve Co. to handle the Federal premium payments. The premiums amount to $28.05 a ton for 60 per cent zinc concentrates and $39.60 a ton for 80 percent lead concentrates, which,

together with the present market prices for lead, bring the concentrate prices to $83.33 and $116.35, respectively, for production that is over-quota and entitled to receive the Federal bonus.

▶ Eagle-Picher Mining & Smelting Co. has started sinking a new shaft on the McKibben land, a quarter-mile south of the Jane E. Mining Co.'s Scott mill, a mile east of Hockerville. The shaft will be put down to a depth of 220 ft., and its sinking has been contracted by Bob Ballinger, of Joplin. When completed, a railroad spur will be extended to the mine site, and ore rock will be sent to the company's Central mill for treatment.

▶ Dines Mining Co. is sinking a new shaft on the Hartley land, comprising 120 acres and situated about half a mile northwest of Baxter Springs, according to H. G. Weidman, manager. The shaft will be put down to the 240-ft. level, where the company plans to open an orebody disclosed by previous churn drilling. Ore rock will be trucked to the company's Blue Mound mill, north of Picher, in Kansas.

▶ Several old shafts are being reopened in an effort to obtain new production that will be subject to the premium prices. Davis-Big Chief Mining Co. is reopening the old St. Louis No. 5 shaft, on the Imbeau land, a mile and a half northeast of Quapaw, according to C. E. Niday, of Miami. W. L. Kepner, of Joplin, manager, reports that the Guaranty Mining & Royalty Co. has taken over the operation of a field shaft mine on the south forty of the Indiana lease, two miles east of Picher, reopening of which was started a few months ago by F. W. (Mike) Evans, of Picher. Evans, who has a lease on the Indiana tract comprising three forties in a row north and south, is reopening a shaft on the middle and north acreages. Ore rock from the south forty will go to the Guaranty mill at Hockerville, and that from the other three properties mentioned will be treated at the Eagle-Picher Central mill. Cluck & Co. are reopening a shaft on the old Smith-Davis Crutchfield, which adjoins the north Indiana forty on the west, ore rock from which will be trucked to the Jane E. Mining Co.'s Scott mill, east of Hockerville. The Guaranty company also is reopening the old Aztec mill shaft, a quarter-mile south of the company's mill. Oldham Mining Co. has resumed mine operations at its properties on the Morrison land of the old H., H. & H. lease, a mile northwest of Baxter Springs, which were recently dewatered again, according to J. W. Hoffman, of Kansas City.

▶ Rialto Mining Corp. has suspended the re-treatment of tailings at its No. 2 mill near Cardin, and is conducting mine operations and the treatment of mine rock at the property, according to Sam Ashe, secretary. Mine operations were suspended at the No. 2 property in July, 1938, when the mill was converted for the re-treatment of tailings. The company is also operating the No. 3 mine and mill, which adjoins the No. 2 property on the west.

▶ J. W. Hoffman, of Kansas City, and associates have acquired an interest in the High Grade Mining Co., which has started mining and milling operations at its properties northwest of Chitwood, it

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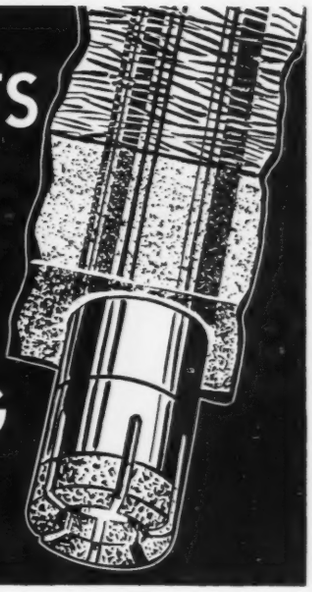

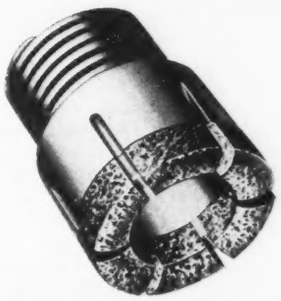

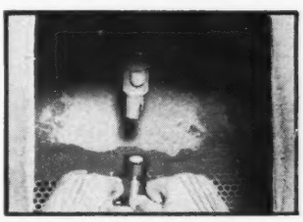

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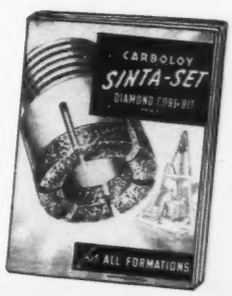

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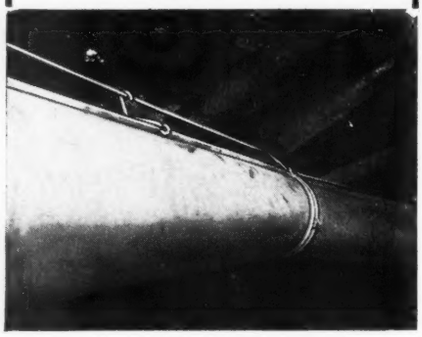

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▶TRI-STATE

was announced by George W. Moore, of Joplin, company president. Associates of Hoffman, who became company treasurer and general manager, include W. S. Rice, of Topeka, who was named vice president, and Fred Livesey, of Kansas City, Kan., who was elected secretary. Prior to starting operations, the company enlarged its mill, dewatered the Southside mines, and completed the sinking of the Northside shaft, where a rich deposit of blende has been opened. A. E. Campbell, of Commerce, former superintendent for the Oklahoma Interstate Mining Co. properties in Oklahoma and Kansas, is in charge of operations, with Newton Doty, of Joplin, as ground foreman.

▶ Captain Milling Co. has purchased three new trucks and 20-ton trailers, which have been put in service in hauling tailings for re-treatment at the company's mill, half a mile west of Treece, according to Charles A. Neal, of Miami. Tailings from the old Netta pile at Picher are being re-treated.

▶ Atlas Milling Co., which was forced down for two weeks in March when a dummy elevator was blown over, has made major repairs and installations in the mill while building a new elevator, W. O. Gibson of Miami, superintendent, reports. A feed conveyor to the mill was rebuilt and three new jigs and two Butchart float machines were installed. Tailings from the Beck No. 1 tailing pile, half a mile to the north, now are being re-treated over the plant.

▶ The new sink-and-float addition to the Sooner tailing plant of the Tri-State Zinc, Inc., in the northeast part of Picher, is being completed, and it is understood the company is enlarging the capacity of its Ottawa mill, northwest of Picher, from 2,100 to 3,600 tons of tailings daily, with the expectation of re-running the huge Ottawa pile. M. H. Loveman and Victor C. Allen, both of Joplin, are, respectively, manager and superintendent of the company.

▶ Rees Milling Co. has taken a lease on the Hays-Manning mine mill, two and one-quarter miles east of Joplin, and has started the re-treatment of tailings from the old Dividend mines, on the Wallower land, northwest of the city. W. E. Rees and son, E. J., both of Joplin, are interested in the company.

▶ Some new churn drilling activity is noted in the district. Eagle-Picher is extending such operations in the Galena area, and also is doing dome prospecting northwest of Chitwood. According to Howard H. Utley, of Baxter Springs, district agent, the St. Louis Smelting & Refining Co. is drilling on the Winchester land, about 10 miles south of Joplin. Considerable drilling was done on the tract by the company about five years ago, Utley said. J. W. Hoffman is putting down some test holes on the Embry tract, four miles west of Baxter Springs, where he has leased 115 acres of land. American Development Co., in which W. T. Landrum and Dewey Simms, both of Baxter Springs, are interested, is conducting a drilling campaign on 1,000 acres of land leased seven miles northwest of Baxter Springs.

UTAH

Mine Earnings Decline As Taxes Go Up

Reports of operations for 1941 show reduced net income of Utah silver-lead producers — Manganese production foreshadowed by Bureau of Mines' tests

▶ Investigations by the U. S. Bureau of Mines of the possibility of producing manganese in the intermountain area foreshadow a considerable expansion of activity in Utah. Reports of the metallurgical division indicate that noteworthy tonnages of manganese ore exist in the Drum Mountain district, Juab County, and in six Tintic district properties. The government program calls for the erection of a hydrometallurgical plant at Garfield to produce 630,000 tons of manganese from Utah and eastern Nevada deposits. The town of Delta, in west-central Utah, has been mentioned as the site for the construction of an ore-dressing plant to produce annually 80,000 tons of manganese. Tests have been directed by Dr. R. S. Dean, chief engineer of the metallurgical division, U. S. Bureau of Mines, of Boulder, Nev., for working out the metallurgy to be used in treating manganese ores.

▶ The search for tungsten ore has stimulated prospecting and development of known deposits in the Beaver district. Development has been started by the U. S. Vanadium Corporation on tungsten claims in the Granite district west of Beaver. Clarence H. Hall is directing core-drilling operations. Alex Ransom is foreman. A. E. McGarry, of Beaver, is directing exploration on a group of claims north of the ground leased by him and Hartley G. Dewey to the U. S. Vanadium Corp.

▶ The Utah Copper Co.'s production of red metal reached a total of 23,500 tons in January. Net proceeds of the company for 1941 amounted to $41,833,336, compared with $31,866,858 in 1940, according to a report filed with the Utah State Tax Commission.

▶ Four other companies reported net proceeds for 1941: Park Utah Consolidated Mines, $212,004.41, compared with $364,990.64 in 1940; Park City Consolidated Mines Co., none, compared with $81,752; Ohio Copper Co., $40,674.35, and $27,254.09; New Park Mining Co., $115,536.58 and $162,235.54. These figures indicate the general trend of returns from Utah silver-lead producers. Increased production have been offset by higher operating costs. Silver King Coalition Mining Co., through James Ivers, vice president and general manager, reports a net profit in 1941 of $395,271 after income taxes and depreciation, compared with $467,076 for 1940, on a production of 116,443 tons of ore in 1941, compared with 101,236 in 1940.

▶ Park Utah Consolidated Mines reported a net income of $158,449 for 1941 after taxes and depreciation, compared with net earnings of $291,318 in 1940. Operations have been resumed at the Keetley property below the drain tunnel.

▶ The Rico Argentine Mining Co., a Salt Lake corporation, operating mines at

Rico, Dolores County, Colo., reports a similar trend. Net earnings in 1941 after taxes and depreciation amounted to $62,074 compared with $94,283 in 1940, although production grossed $411,052, compared with $393,069 in 1940.

▶ Mercur Dome Gold Mining Co., at Mercur, reports its shaft nearing the 850 level. The National Tunnel & Mines Co. has unwatered the Rood shaft of the Utah Apex mine, at Bingham, to the 3,300, or bottom level, 900 ft. below the level of the 5-mile drain and transportation tunnel.

WASHINGTON

Holden Copper Mine Producing Heavily

Higher priority rating for producers of zinc will help operations of American Z. L. & S. Co. in State.

▶ Strategic Metals Co. has been organized at Yakima to develop high-grade manganese properties 40 miles away. Mrs. H. E. Growdon and W. C. Thorp, local residents, the latter having discovered the deposits, are interested. Some tests have been made.

▶ Operations of the Pateros Gold Corp. on the Methow River have been slowed up by lack of a bridge across the stream. Ore has been developed from the 200-ft. level. Values are chiefly in gold, with some silver and copper, according to James W. Turner, of Spokane, president and manager.

▶ Howe Sound Co. is engaged in heavy production at its Holden mine, above Lake Chelan. Its annual report says plans have been made to increase mill capacity 10 percent. A cyanide plant to treat tailings has been installed and favorable results have resulted from the extension of the shaft 550 ft. below the main haulage adit. New hoists are to be installed.

▶ D. I. Hayes, manager for American Zinc, Lead & Smelting Co. in the Metaline district, reports that the high priority rating given zinc producers will facilitate uninterrupted operations by the company's two subsidiaries, Metaline Mining & Leasing Co. and Grandview Mining Co. The rating was A-3 and is now A-1-c.

▶ C. S. Anderson, who owns the Lake Crescent manganese property on the Olympic peninsula, which he has leased to Sunshine Mining Co., says the manganese occurs in red limestone. The lease provides for shipment of 10,000 tons.

▶ Anxious to secure a mill or other reduction plant to treat Stevens County ores, the Colville Chamber of Commerce met March 12 to consider the possibilities. Sheldon Glover, State Supervisor of Mining, said that a survey is being made to determine the extent of these mineral resources.

▶ Conrad Wolfle is reopening the United Copper mine, 4 miles northeast of Chewelah. He has cleaned out the 4,000-ft. tunnel, torn down old buildings, and is rebuilding the bunkhouse, cook house,

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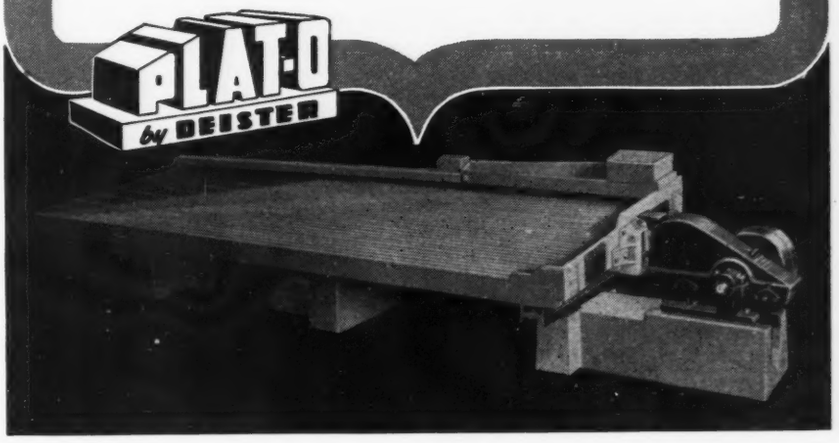

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▶WASHINGTON

and office. He holds that there is a good tonnage of milling ore available, which was left when the mine was abandoned in 1919 because of the drop in copper price. He has purchased a mill, which will be moved in when the weather permits.

▶ Work on the magnesium plant for the Union Carbide & Carbon Co. in eastern Washington has been started. The ferro-silicon process will be used.

▶ Young American mine, near Bossburg, in Stevens County, has been acquired by Cuprite Mining Co. of Yakima, which expects to ship silver-lead ore to the Tacoma smelter. The orebody, in black lime, is 1 ft. to 18 in. in width and is almost flat, dipping 8 to 10 deg. from the horizontal.

▶ Kaaba-Texas Mining Co., at Nighthawk, 13 miles west of Oroville, is installing its machinery preparing to extract about 200,000 tons of ore, according to Lee B. Carroll, manager. The mill capacity will be 200 tons a day. He reports that the ore values are about evenly divided among silver, lead, and zinc.

CANADA

African Cobalt Recovered In Deloro Plant

Sudbury's yield of platinum-group metals exceeds $8,000,000 in 1941—Sherritt-Gordon installs flotation to recover zinc

▶ Treatment of cobalt residues or "alloy" from copper mines in the Belgian Congo has been handled by cobalt reduction works in the United States and Canada ever since the German occupation of Belgium, according to a report by the Dominion Bureau of Statistics. Deloro Smelting & Refining Co., formerly operating on cobalt ores from the camp of Cobalt, Ont., now treats only the African ores and is stockpiling shipments from several Ontario mines worked on a small scale under lease.

▶ Platinum, palladium, iridium, rhodium, and osmium, produced in association with the nickel-copper ores of the Sudbury district, had a total value in 1941 of $8,145,692, compared with $7,761,108 in the previous year. Canada's output leads the world.

▶ The combined value of asbestos, fluorspar, graphite, mica, magnesitic-dolomite, and sulphur increased last year to $24,516,593 from production in 1940 amounting to $18,205,399.

▶ Maryland Porcupine Mines, several miles southwest of the Naybob, is being financed by Detroit interests for a diamond-drilling program to test three favorable mineralized shear zones discovered on surface. One has been opened by a two-compartment shaft to 114 ft. Work is supervised by Hamlin B. Hatch, consulting geologist.

▶ Buffalo Ankerite is opening up promising new ore in the south zone. A 12-ft. width of ore, better than mine average in grade, is exposed for 200 ft. on the 1,700-ft. level and about 100 ft. has been developed on the 2,000-ft. level. Exploration is proceeding. Shaft sinking is progressing below 2,800 ft., with quartz stringers carrying visible gold intersected in the last 100 ft. Last November the mill worked up to a new record of 1,332 tons a day. Average grade treated in the final quarter of 1941 was $5.85. R. P. Kinkel is manager and E. C. Keeley mine superintendent.

▶ Labor trouble at Kirkland Lake was reflected in a 15 percent drop in gold output for that camp in 1941 and a 2.18 percent decrease for all of Ontario at $122,844,383, compared with $125,579,597 in 1940. Seven properties with a combined capacity of 3,595 tons suspended milling and four new gold producers put mill equipment into use rated at 1,115 tons a day. Output from Larder Lake jumped 39 percent last year but the scale of operations in other parts of the Province remained about as in 1940.

MANITOBA

▶ Combined mineral production from Manitoba and Saskatchewan in 1941 was $32,714,190, against $29,334,380 the year before. As in other parts of Canada, there was a continued decline in prospecting activity, with only 554 mining claims recorded, as compared with 832 claims in 1940 and 1,320 in 1939. Howe Sound Exploration Co. has leased the Snow Lake property of Nor-Acme Gold Mines and is diamond drilling. Hudson Bay Mining & Smelting Co. is exploring the Thompson property and other claims at Schist Lake.

▶ Forty-four Mines, adjoining San Antonio, has carried on deep exploration by a crosscut from San Antonio's eighth level, advancing 480 ft. into Forty-four ground and putting down eight drill holes without indicating ore possibilities. Good geological structure is to receive additional attention. John D. Perrin is president of both companies.

▶ Two new levels at 1,875 and 2,000 ft. are expected to determine the life of operations at Gunnar Gold Mines. In the past year only limited ore was developed to replace the 50,736 tons milled for a recovery of $577,374. Development on the Rockland-Ogama property, 7 miles from Gunnar, has shown enough ore to pay for the investment to date. It is proposed to haul the ore to the Gunnar mill. Fraser Reid is consultant and James Houston mine manager.

▶ Hudson Bay Mining & Smelting Co. increased milling capacity last year from 5,250 to 6,000 tons a day. Old machinery was overhauled and new equipment added. A 10-ton pilot plant has been treating the zinc residues stockpiled from the start of operations at Flin Flon. The South Main shaft has been completed to 3,000 ft. and no more ore is being hauled to surface from the open pit. A new 300-ft. level at the north end of the pit and a series of ore passes at the south end made possible the changeover to underground mining in this area. W. A. Green is general manager, R. H. Channing is president, and Cornelius V. Whitney chairman.

Located 40 miles northeast of Flin Flon, Sherritt Gordon Mines is investing $125,000 in a flotation plant that will produce an estimated 50,000 tons of 50 percent zinc concentrates before the end of next year. At present mining about 2,000 tons a day, copper concentrates are shipped to the Hudson Bay smelter, but no effort had previously been made to recover zinc from the tailings. Eldon L. Brown is general manager.

BRITISH COLUMBIA

▶ British Columbia's Department of Mines has published Part I of the report on the proposed iron and steel works, prepared by Arthur G. McKee & Co., Cleveland, Ohio. The plan involves production of 75,000 tons of finished steel products annually. The four western Provinces, now consuming 110,847 tons of such products per year, would constitute the market. Raw materials used annually would include 150,000 tons of iron ore, 100,000 tons of coal, 10,000 tons of limestone, 25,000 tons of purchased scrap, 200 tons of fluorspar, and 580 tons of ferro-alloys. Union Bay, on the east coast of Vancouver Island, is recommended as the most favored site. Here beehive coke produced from washed Comox coal would be available as well as potential power. The report states that 1,750,000 tons of magnetite concentrate could be had within a short water-haul of Union Bay. Blast furnaces are recommended.

▶ At the session just concluded, the British Columbia Legislature enacted amendments to the Mineral and Placer Mining, Iron, and Steel Bounties, and Taxation Acts. The Mineral and Placer Act was amended to clarify the provisions requiring recording of excess assessment-work on claims within the year in which it is performed; and to facilitate and improve administrative services. The amendment to the Iron and Steel Bounties Act extends from five to ten years the contractual period during which a bounty is earnable. Section 62 of the Taxation Act was amended, rescinding the tax of 27½c. a ton on iron ore mined and removed from a property if the ore is smelted in the Province.

▶ Ventures, Ltd., has an option on the Anyox smelter and plant and proposes to start making steel from scrap as an introductory step to building a permanent steel industry which will eventually utilize local magnetite, hematite, and limonite. Ventures has been getting options on some properties known to have iron-ore deposits. Two officials active in this enterprise are W. B. Maxwell and George M. Lee, last general superintendent and last smelter superintendent, respectively, of the former operation by Granby at Anyox.

▶ Net smelter returns of $117,199 from 13,120 tons milled, averaging 0.25 oz. gold and 3.94 oz. silver per ton, were obtained by Silbak Premier from February output.

▶ Surf Inlet Consolidated obtained net smelter returns of $44,766 from 1,282 oz. gold, recovered from 2,905 tons, averaging $15.40 per ton, in February.

▶ Privateer Mine produced 2,107 oz. gold, valued at $81,120, from 2,662 tons, aver-

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▶BRITISH COLUMBIA

aging 0.791 oz. gold per ton, in February.

▶ Operations of Spud Valley Gold were curtailed in February. Production showed a marked drop, being valued at $31,141 from 2,731 tons, averaging $11.40 per ton, compared with $42,101, from 3,422 tons, in January.

▶ January production of Central Zeballos, Reno subsidiary, was valued at $26,843 from 1,330 tons of ore milled.

▶ Tests are being made at the big Bridge River property of Bralorne Mines to recover a tungsten concentrate as a by-product of gold mining.

▶ February production of Bayonne Consolidated was valued at $25,129, compared with $27,830 in January.

▶ Ymir Yankee Girl reports January output valued at $43,482 from 4,420 tons milled. Net smelter returns were $33,-565.

▶ Production of Kootenay Belle in February was $39,154 from 3,230 tons.

▶ Gold Belt Mining Co.'s February production was valued at $60,368, from 4,683 tons.

▶ Sheep Creek Gold's February production was 2,203 oz. gold, valued at $77,110, from 4,518 tons.

▶ Reno Gold Mines, Ltd., meeting on March 12, approved a return of capital amounting to 20c. per share and involving $376,000. Par value shares will be reduced from $1 to 80c. as a result. The treasury will still have a cash balance of approximately $50,000 after the distribution.

▶ Cariboo Gold Quartz produced 4,064 oz. gold, valued at $156,464, from 9,332 tons, averaging 0.44 oz. gold per ton, in February.

▶ During the year 1941, Island Mountain Mines Co. produced 24,753 oz. gold and 3,537 oz. silver, valued at $954,248, from 54,398 tons, averaging 0.455 oz. gold and 0.06 oz. silver, equivalent to $17.54 per ton. Net profit was $282,218.

MEXICO

Labor Troubles Continue for Mine Operators

Outstanding for its length, the strike at El Indio, in Nayarit, has lasted two months. Cooperatives in difficulties

▶ Labor trouble continues in Mexico, despite the pledge of the national miners' union to the Government to refrain from acts that would obstruct production. The Labor Ministry is trying to end what is the longest strike in recent Mexican mining history, that at El Indio's property in Nayarit, which began Jan. 26.

▶ The Labor Ministry also intervened to correct troubles that threatened suspension for the Cia. Min. de Santa Maria del Oro, at El Oro, Dgo., a lead producer. Workers have agreed to arbitrate.

▶ Work has returned to normal at the property of Cia. Min. de San Carlos, San Carlos, Chih., with settlement of a dispute, granting a 5-percent wage increase and free transportation of food and other supplies for the employees.

▶ The San Rafael mining cooperative at Pachuca, Hgo., has succeeded in getting the Government to pay the bill it owes the electric power company. The latter had threatened to suspend service.

▶ The miners' union has protested to the Labor Ministry against suspension of operations by Cia. Min. y Beneficiadora de Metales, S. A., Oscar Lamp, general manager, Pinos, Zac., and the Cia. Min. de San Vicente, S. A., San Vicente, Sin. Both companies advised the Ministry that unprofitable business forced them to suspend.

▶ Neg. Min. Recompensa, in Durango, straightened out a labor dispute by granting a slight increase in pay and other concessions, including permission for the workers to organize a consumption cooperative society.

▶ Mercury production which has been declining promises to increase. A company has been organized to exploit deposits at San Marcos, Mazapil, Zac., according to the Ministry of National Economy, which has granted this concern a concession. The company is headed by Harold Robinson, Ignacio Martinez, and Juan Jimenez. Its property is close to the Mexico City-El Paso line of the National Railways.

▶ The miners' union has assessed all members in the Pilares de Nacozari district, Sonora, a day's pay to build a fund to sustain the strike it threatens against Nacozari Consolidated Copper. The union is demanding a new contract with higher pay.

▶ Books of Mexican Candelaria, at Contraestaca, Sin., are being examined by auditors assigned by the Federal Board of Conciliation and Arbitration assigned in connection with the company's request for authorization to suspend.

▶ Experimental cooperative working of mines of Cias. Mineras El Carmen and Angustias, San Luis de la Paz, Gto., that began recently as a means of ending almost continuous labor troubles, is a dismal failure, said to be due to mismanagement, friction among the societies' executives, and theft of ore by supposed prospectors. Suspension would deprive numerous miners of jobs.

▶ Azufre Refinado, S. A., a sulphur refining company, using sublimation, with headquarters at Paseo de la Reforma, No. 30, Mexico City, is to start May 21 under federal franchise which allows it exemption from national taxes for five years and free imports of all necessary equipment.

▶ Asarco has been permitted by the Ministry of Finance to export impure copper in bars for refining for an unlimited period, provided the refined metal is returned to Mexico.

▶ Investigation is being made of the plight of the cooperative that for several years has been working properties of Cia. Min. Dos Estrellas, S. A., El Oro, State of Mexico, and Tlalpujahua, Mich. The society has petitioned for a Government subsidy of 30,000 pesos ($6,250) a month and suspension of tax collections. It claims a membership of 4,500.

▶ Peace with its workers was made by the Cia. Min. Nochebuena, S. A., Melchor Ocampo, Zac., by allowing a 12 percent pay raise and contributing 10,000 pesos ($2,250) so that the employees may establish their own consumption cooperative.

▶ Production of minerals and metals in Mexico during Jan.-Nov. periods of 1940 and 1941, according to the Mexican Department of Mines, figures in kilograms:

	Jan.-Nov. 1940	Jan.-Nov. 1941
Gold	25,492	23,252
Silver	2,428,322	2,264,814
Copper	33,421,158	44,399,950
Lead	185,047,778	149,744,038
Zinc	100,910,340	132,301,795
Antimony	11,050,754	10,410,572
Graphite	11,548,754	16,086,193
Quicksilver	331,974	703,666
Arsenic	9,001,765	11,574,963
Cadmium	784,504	799,549
Tin	334,455	198,158
Molybdenum	397,543	791,800
Manganese	992,098	841,911
Bismuth	185,433	97,971
Tungsten	102,801	91,095
Iron	63,347,992	66,019,360
Vanadium	56,962	598

▶ Employees of Cia. Minera La Fortuna, S. A., Urique, Chihuahua, with Thomas Miranda, Choix, Sinaloa, legal representative, sent a delegation to Mexico City to petition the Labor Ministry to arrange for them to assume charge of the business and run it cooperatively. This company ceased work because it was unprofitable. It owes a large bill for electric power. the delegation told the Ministry.

▶ Labor peace, for the time being at least, was attained by Cia. Minera de Guazapares, S. A., Guazapares, Chihuahua, by making a new work contract.

▶ Installation of additional equipment to step up production is being completed by the mercury mines at Mesa del Toro, Guanajuato, operated by interests headed by Lowell J. Ridings, 401 Rule Building, Mexico City.

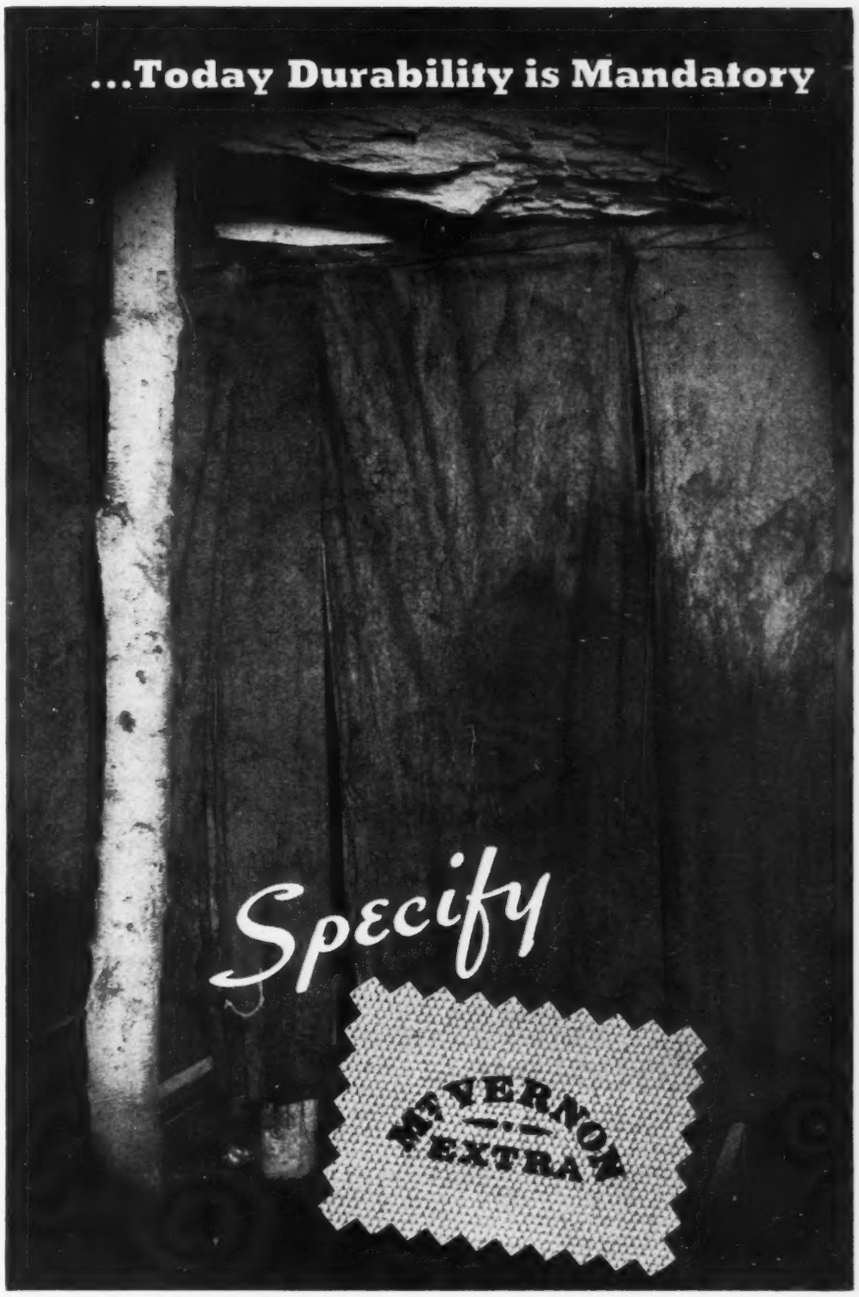
▶ El Favor mines, Jalisco, have been delivered to their workers to operate cooperatively for an indefinite term because their owners found the work unprofitable. The workers have all use rights to machinery, tools, etc., and will pay 4 percent of their profits for the lease.

PERU

Banco Minero Seeks Custom Mill Sites

Heavy rains cause great damage to roads and mining properties in Central Andean region—Production of electrolytic zinc and molybdenite increasing

▶ The Huachocc mine, belonging to Compañia Aurifera Caraveli, and located at Huachocc, 40 miles north of Lima by car, started operations early in February. The mine started as a not very hopeful prospect some three years ago, with only a good outcrop and small workings made by the early Spaniards. A crosscut was made which cut the main vein, but the width and the grade were not promising. Another crosscut was then driven below, and the sulphide zone appeared in a



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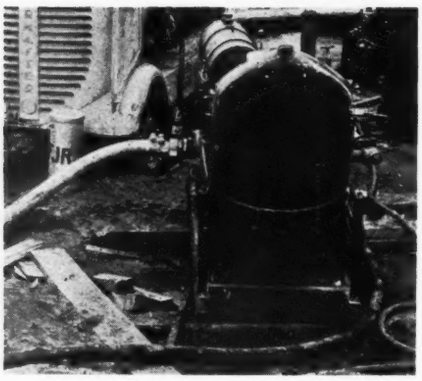

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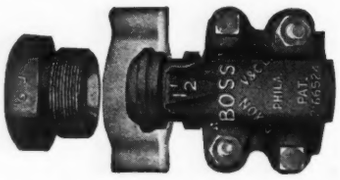

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PERU

2½-ft. vein with high copper and gold values. This zone is now being worked. A concentration plant was installed, consisting of a 5x5-ft. mill, six Denver Sub-A No. 18 flotation cells, one unit cell, two large Wilfley tables, and a thickener. The mill has a capacity of 70 tons a day, but is only treating 60 tons at present. The mineralization is confined to fractures in the granite. Minerals are chalcopyrite, bornite, chalcocite, and pyrite, and the average content of economic minerals is as follows: Copper, 1½ to 2 percent; gold, 0.3 to 0.4 oz. per metric ton; silver, 3 to 4 oz. per metric ton.

▶ The Santa Rosa gold mine, belonging to the Saramarca group, and located near Jaqui, in Southern Peru, only 35 miles from the coast, is now being operated successfully. Ore is gold-bearing quartz, which appears in granite, connected with phonolite dikes. There are three large veins, each averaging 3 ft. in width, and six smaller veins, averaging 2 ft. Ore carries 0.3 oz. of gold per metric ton. Cyaniding plant has a capacity of 450 tons a day, but is now treating only 300 tons.

▶ Peru produced in 1940, 281,259 oz. of fine gold. Of this total, Cerro de Pasco Copper Corp. produced 84,309 oz. as a byproduct of silver, copper, zinc, and lead ores. Figures for 1941 are not as yet available, but it is certain that such production will have been the largest in the history of the country.

▶ Recent heavy rains in the Central Andean region, worse than any year since 1925, caused a great deal of damage to roads and installations during January and February. In the Central Sierra the auto road between Lima and La Oroya, Cerro de Pasco Copper Corp.'s smelting center, was severely damaged and broken by landslides at many points. Worst damage occurred in vicinity of Viso and Matucana, on the same highway, and auto communications with local mines have been rendered very difficult. A real catastrophe occurred in Huaraz, Callejón de Huaylas, when large quantities of water accumulated in a high lake were dammed by a glacier, and finally broke through, wiping out half the town and killing more than 2,000 persons. The wave, which carried boulders up to 20 tons in weight, continued down the Santa River and destroyed four railroad bridges and about 20 km. of rails. All mining in that Ancash zone, which mainly produced coal, tungsten, and gold, has been greatly hampered by lack of communications. The railroad is now being repaired, but probably will not run till the end of the year.

▶ Banco Minero del Peru was one year old in March. The Banco is increasing its activities. The 50-ton custom mill at Castrovirreina has caused marked increase in local mine development. The Dollar property, near the mill, with a 6-ft. vein carrying 0.2 oz. of gold and 25 oz. of silver, is now being developed, with good prospects. Production of lead, copper, and silver concentrates at the plant more than doubled in the last year. Eight new flotation cells made in Lima by the Eagle Iron Works, and a 6x6-ft. conditioner will soon be installed at the plant for selective flotation. Zinc concentrates will thus be obtained.

▶ The Banco is now studying possibilities for the installation of several custom mills in other regions of Peru. Best location so far seems to be Huachocolpa, near Huancavelica, where lead-zinc ores are very abundant. Rublo, the largest property there, has a considerable tonnage of ore containing 12 percent zinc, 14 percent lead, and 8 oz. of silver.

▶ Pilot electrolytic-zinc plant at La Oroya (Cerro de Pasco Copper Corp.,) increased its production of zinc bars from 178 tons in 1940 to 704 tons in 1941. A large plant is still in the blueprint stage.

▶ Peru Molibdeno, S. A., only large producer of molybdenum in Peru, has cut a new vein, 3 ft. wide and carrying 1.2 percent molybdenite. The company's flotation plant at present has a capacity of 160 tons a day, but a vast program for developing the property will probably result in an increase in the capacity of the property.

AFRICA

Production of Gold Holding Near Normal

Attempts made to sabotage gold-mining industry—Increasing demand for industrial diamonds—Britain buying mineral output of Belgian Congo

▶ Because of Malaya being overrun, Siam cut off, and the Dutch East Indies and Burma threatened by the Japanese, the tin production of the rest of the world is being closely studied. It is proposed to bring the mines of Cornwall back into full productive activity, with government assistance in expectation, and to make such arrangements as may be necessary to encourage increased output from Nigeria. Whether miners will be released from the enlisted services to build up the Cornwall working forces, or whether financial assistance will be supplied out of hand or a guaranteed price for the total production of the district will be offered are matters yet to be determined.

Cornwall will require a lot of new machinery and equipment if it is to reopen its many derelict mines, most of the existing machinery being obsolete. The mines operating there now are unable to win any appreciable profit even on the prevailing high price of tin. The position is to be surveyed immediately. There are many unusual features to be considered, including shipping facilities and the fact that many factories usually making mining machinery are now occupied in munitions. Surveys so far carried out make it quite clear that the war is not to be lost through a shortage of tin. Stocks are relatively large and it is considered likely that the Belgian Congo, Nigeria, Bolivia, and Cornwall can together produce at the rate of 80,000 to 90,000 tons a year. There is sure to be tin enough this year and probably enough for most or all of next.

▶ Attempts have been made to interfere with or stop gold production in the Witwatersrand area. Electric pylons

carrying the wires which bring power form Victoria Falls have been bombed in a few cases, as has one local power station, and telephone wires have been cut. This is assumed to be the work of Fifth Columnists, so the death penalty has been provided for sabotage. All damage done so far has been quickly repaired, and the authorities seem to have the situation well in hand.

▶ All Witwatersrand producing mines are operating at full capacity. The total output in January was, judged from early returns, slightly below that of December, though a number of mines increased their output. There was no noteworthy decrease anywhere. What is noteworthy is that the latest quarterly reports indicate that ore reserves were drawn upon slightly during the past year, advance development work in several cases being reduced somewhat. Present production is considered more important than preparations for the distant future.

▶ Blyvooruitzicht Gold Mining, which is developing sensationally rich ore in the so-called "Carbon Leader" in the West Witwatersrand area, extended its openings 1,740 ft. during the December quarter. This consisted of further driving on the two levels at 4,650- and 4,830-ft. depths, four raises and one winze. The new openings on the reef, like all that have preceded, revealed payable ore averaging 48.8 dwt. over widths averaging 14.3 in. This is somewhat lower than averages previously encountered, but is several times higher than the Witwatersrand district average. The first unit of its new reduction plant, which will have a capacity of 8,000 tons monthly, is reported proceeding satisfactorily. Though the cyanide section is not yet completed, actual production has started with recovery of gold by corduroy concentration and amalgamation. Development ore will be treated to assist in defraying expenses.

▶ Sherwood Starr is reported to be struggling against declining ore values and increasing production costs. Ore reserves are believed in the process of being reduced. The management intimates that the mine is likely to be exhausted within a further four and a half years, with perhaps an additional one and a half years' production from mine pillars.

▶ Conditions in the diamond mining industry were explained, with his usual clearness, by A. Chester Beatty, in the report of Consolidated African Selection Trust. "The market in gem stones continues to be restricted," he said, "but the demand for diamonds suitable for industry has expanded, and we are making every effort to maintain our output to insure adequate supplies for the war needs of our country and Allies." Consolidated African Selection Trust's profit for the year ended June 30, 1941, was £351,357, against £418,011 the previous year. Stocks of diamonds on hand are carried at the nominal valuation of £1, which hardly can be an overvaluation. The company has immense areas of proved ground and further promising areas to be prospected.

▶ Some gold is still being produced in Kenya Colony, though activities there are tending to diminish. Kavirondo sold £55,877 worth of bullion last year,

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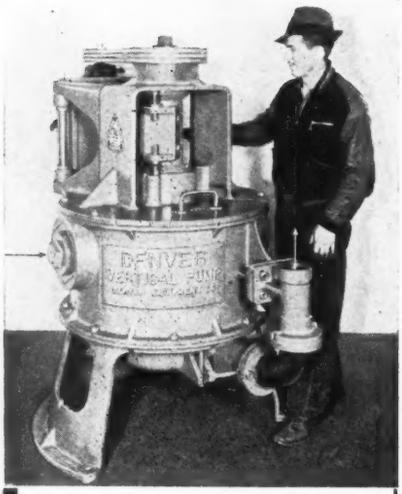

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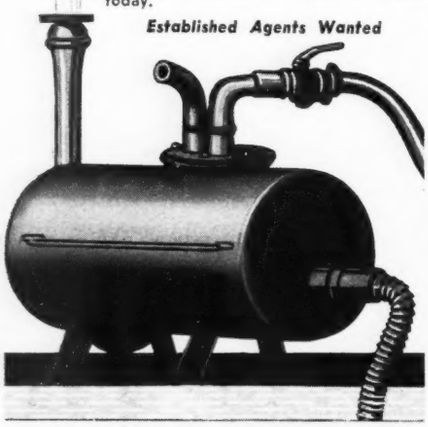

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▶AFRICA

against £47,634 the preceding year, and made a net final profit of £2,235, against a loss of £6,331. It also stands to receive a refund on account of overcharged royalties.

▶ Tests are being made to determine the practicability of using cadmium as a substitute for tin in plating. Cadmium is one of the metals under price control in Britain. It is reasoned in metal circles that if a substitute for tin is to be discovered, prevailing conditions will cause it to be found before the end of this war.

▶ Most friendly relations have been established between Great Britain and the Belgian Congo. The former is now taking all, or practically all, of the latter's mineral output. This is important, as the Belgian Congo is among the world's largest producers of copper, cobalt, and radium, and is a considerable producer of tin, gold, and some other minerals. Before the war the Belgians would not grant concessions or other mining privileges to British companies. Whether this rule would now be altered, or if altered by the Belgian Congo Government would be respected by the Belgian government after the war, is a problem that seems likely to prevent any flow on British capital into that colony. But the possibilities are otherwise highly attractive. It has been estimated that the Belgian Congo will produce as much as 8,000 tons of tin this year. This estimate is probably much too low.

▶ What has been considered to be a rule has been broken by Vlakfontein, the new East Rand producer. It has reported a small operating profit from its first month's operations. A loss is expected to be shown the first month. Western Reefs, for instance, lost £18,000 in July last year, but still was able to begin paying dividends in December. Vlakfontein, Blyvoors, and Western Reefs make three new producers for the Witwatersrand district, two of which have come in the third year of the war.

AUSTRALIA

Gold Mining Continued Active in Past Year

Great Boulder's reserves at 1,500,000 tons with monthly output at 35,000—Broken Hill North and South companies report

▶ Great Boulder Proprietary continues active development with good results. Deep-level work has been encouraging. Lowest workings are in the Hamilton shaft section, where the north drive on the 2,800-ft. level was advanced 109 ft. in the quarter ended Aug. 25, 1941, in ore assaying 5.4 dwt. gold over 6 ft.; the corresponding south drive averaging 8.8 dwt. over 6 ft. for 28 ft. Winzing is 95 ft. below the 2,950-ft. plat. Ten years ago Great Boulder was regarded as derelict. Sound advice and capable management have raised it to a leading place, with reserves at 1,500,000 tons and a monthly output of 35,000 tons. The leases contain not fewer than 16 lodes, many of which, particularly the cross lodes, were largely neglected but which are now developing satisfactorily.

▶ Wiluna Gold, at Wiluna, 350 miles north of Kalgoorlie, reported a net profit of £A200,889 for the year ended March 31, 1941, compared with £A173,610 for the previous year. No dividends were declared, the work being held salvage. Operating life is stated to depend on deep development and maximum rate of output is expected until June, 1942. Reserves have not been appreciably reduced, but grade continues to drop. A new property, Mount Charlotte (Kalgoorlie) Gold, is under option, at a price of £220,000. Diamond drilling by the vendors is stated to have shown over 1,000,000 tons of 5.6-dwt. gold ore and active development is to be done.

▶ In the Department of Mines annual report for 1940 interesting statistics are given on Western Australia mine accidents. Total labor employed was 15,274, compared with 15,944 in year before, and of these gold mining accounted for 14,593 in 1940 and 15,216 in 1939. Accidents numbered 1,403 serious, and 28 fatal; the classification is tabulated. Average rate per 1,000 men employed in gold mines was 1.71 for fatal and 77.23 for serious accidents. The increase in the number caused by falls of ground is perhaps due to influx of new men.

	1939		1940	
Classification	Fatal	Serious	Fatal	Serious
Explosives	6	13	3	11
Falls of ground	8	85	12	113
In shafts	9	42	4	30
Miscellaneous underground	9	906	2	958
Surface	3	346	5	286
Fumes	4	3	2	5
Total	39	1,395	28	1,403

▶ Boulder Perseverance, Ltd., operating on the Golden Mile, Kalgoorlie, in its report for 1940, shows little variation in tonnage and grade mined compared with the previous year, though the grade is 0.291 dwt. per long ton less than in 1938. Tonnage was 116,181, the grade being 6.83 dwt. gold and the revenue £A372,018. Reserves totaled 490,300 tons of 6.18-dwt. ore. Development continued active. The deepest level is at 2,200 ft., showing 4.8 dwt. over 5 ft. Working costs, in Australian currency, per long ton, totaled: 35s. 11.72d.

▶ Kalgoorlie Enterprise Mines, adjacent to and controlled by Boulder Perseverance, operated successfully in 1940. The deposits are similar to those of Boulder Perseverance. Reserves were 422,800 tons of 6.46-dwt. ore. Working costs in Australian currency were 36s. 11.13d. At the 1,508-ft. level the Perseverance lode shows 6 dwt. and the Greenhill shoot 7 dwt. Ground between these levels, 542 ft., has not yet been explored. Diamond drilling has proved the lode to continue to 154 ft. below the 2,050 level.

▶ The leading mine in the Mt. Magnet field is the Hill 50 Gold. This West Australian district is noted for occurrence of gold associated with ferruginous quartzite, or jasper. This is common elsewhere in the State, but gold does not usually persist in workable amount below 100 to 200 ft. At Hill 50, orebodies maintain a highly payable grade down to 500 ft., with prospect of continuity below. The report for the year

to May 31, 1941, shows that 27,072 tons of 7.64-dwt. ore was treated, yielding 10,343 oz., giving £A43,887 profit. Reserves are put at 291,564 tons averaging 5.94 dwt. gold. The company intends to increase output by 15,000 tons per annum and the mill is being enlarged. The completed plant is expected to reduce working costs by 10s. Costs for the period were 45s. 11.0d.

▶ In New South Wales, North Broken Hill and Broken Hill South have issued reports for the year ended June 30, 1941. Owing to wartime regulations, much of the usual interesting information has been omitted.

▶ North Broken Hill had a net profit of £A492,624, out of which dividends totaling £A210,000 were paid, £A71,392 was appropriated for new plant within the year, and £A50,000 for new plant during the year to June 30, 1942. Results of development were satisfactory. The North section produced 82.9 percent of the ore mined, and the British section the balance. The main feature has been the success attaching to extraction from lode pillars, 23.8 percent of the total mined being from this source. Recoveries in the new mill, which combines jigging and tabling for recovery of coarse lead and flotation for slime lead and zinc concentrate, are shown in the table. Reserves in the North, British, and Junction sections are estimated at 5,232,000 long tons, against 5,223,000 the year before.

	Year Ended June 30		
	1939	1940	1941
Lead	94.6%	95.5%	96.2%
Silver	87.4%	88.1%	91.5%
Zinc	83.2%	86.5%	86.0%

▶ Broken Hill South earned a net profit of £A341,051 and paid £A320,000 in dividends. Reserves were put at 2,250,000 long tons, no allowance being made for ore disclosed by diamond drilling only or by limited development work, nor for ore below the 1,480-ft. level. On the 1,790-ft. level the channels have been narrow, save in sections where widths up to 30 ft. have been exposed. Diamond drilling did not prove orebodies of notable size. In the mill, where the treatment is like that on North Broken Hill, metal recoveries were: lead, 96.1 percent; silver, 92.2; and zinc 89.1. The chief feature underground was the adaptation of hydraulic filling to the mine's requirements.

▶ Construction of the Harrietville (Tronoh), Ltd., company's dredge at Harrietville, northeast Victoria, in the Bright gold field, is proceeding. Completed, the dredge will weigh 4,713 tons and will be one of the largest built. Pontoon dimensions are 300x72x12.5 ft. deep. Buckets are of 20-cu.yd. capacity and the digging range is to 130 ft. below water line, actual capacity being 350,000 cu.yd. per month. There are two 40x8-ft. screens and, in the gold-saving section, 16 placer primary jigs and four Crangle jigs. Operations will include resoiling. The stacker boom is 210 ft. long, weighs 100 tons, carries two 42-in. conveyor belts capable of delivering 1,575 tons per hour, and is supported by a 150-ft. mast. Installed electric power will be 1,675 hp. The property contains 96,000,000 cu.yd., the average depth is 85 ft. and

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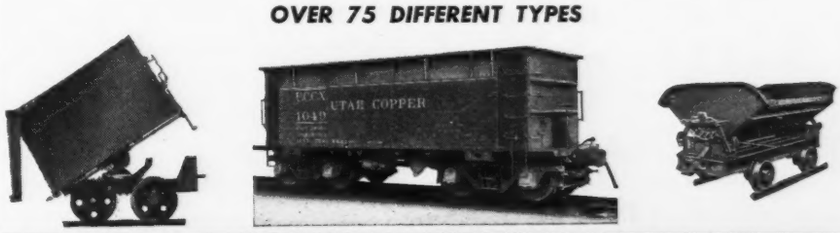

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▶AUSTRALIA

the average value 1.92 gr. gold per cu.yd. Life is put at 22 years.

▶ Emperor Gold, in Fiji, for the year to June 30, 1941, showed a profit of £A219,275. Progress was satisfactory. Record development has been done, 8,690 ft. having been completed, largely in the sulphide zone. Sinking the Wallace Smith shaft continued and No. 7 level opened out at 648 ft. from surface. In the bottom levels the orebody is becoming confined to more defined channels. The high-grade shoot exposed on the No. 3 level of the Loloma mine has been cut in the Emperor workings, and geological evidence favors the existence of flat lodes at depth. In treatment attention has been given to semi-sulphide and sulphide ore. Investigations into roasting of concentrates have recently given satisfactory results and two duplex roasting furnaces are to be installed, by which recovery will be increased to 96 or 97 percent. Working costs in Fijian currency totaled 29s. 9.59d., exclusive of income tax, head office expenses, depreciation of plant and amortization.

▶ Loloma (Fiji) Gold Mines earned £A237,874 profit in the year to July 31, 1941. Record development was accomplished, the footage being 6,682 ft. Working costs, exclusive of taxation, head office expenses, depreciation, and amortization, expressed in Fijian currency, were 52s. 10d., plus 25s. for development redemption. The force is 399 men, comprising 25 Europeans, 34 Eurones ians, and 340 Fijians.

▶ In New Guinea, Yodda Goldfields, Ltd., working alluvial areas in the Yodda gold field on the upper Mambare River, treated 48,270 cu.yd. of ground by sluicing and boxing during the year ended April 30, 1941, obtaining 884 oz. of gold. Average value was 2s. 4d. per cubic yard, and net income, after deducting gold tax and charges, was £A6,697, giving £A2,078 profit. The Yodda Creek area is being reopened and it is intended to reopen McLaughlin's Creek.

Hydraulicking operations at the property of Briseis Consolidated, N. L., a tin-mining enterprise at Derby, Tasmania

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NATIONWIDE SALES AND STOCKS

▸ WASHINGTON REFLECTIONS

(*Continued from page* 42)

ores in Cuba. The company's engineers and metallurgists have been working for some time in a test plant on the Gulf Coast of Texas to develop a new process of treatment. The deposit covers a large area on the northeastern end of the Island, extending on the surface for miles like a huge mineral mantle partly covered by jungle. The deposits have been known for 30 years or more, but had not been previously developed, on account of their low grade and the difficult metallurgical problem involved.

Magnesium Brines—During the search for new magnesium processes, discovery has been made of rich and extensive brine deposits three times as rich in magnesium chloride as those hitherto worked. W.P.B. Executive William Batt announces that this material will be used for much of the extension of the magnesium program, contracts for which were reported in the previous issue of *E.&M.J.*

Sponge Chromium—Bureau of Mines metallurgists recommend pilot-plant trial of a process for making sponge chromium which has been successful on a glassware laboratory basis. Even low-grade chromite is suitable as raw material. But the requirement of considerable chlorine is a serious handicap in prospective development. The process consists of a low-temperature reduction without sintering, followed by volatilization of the chromium as chloride for subsequent reduction to metal by hydrogen. Scientific results are reported in Bureau of Mines Bulletin 436, entitled "Sponge Chromium," available at 20c. from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Easier Import—Import of ores and concentrates of cadmium, zinc, lead and copper is now more conveniently arranged since these commodities are no longer restricted by Import Order M-63. Control of these goods after they are within the United States is now practical by other means. Hence, the old rigid import restrictions could be, and have been, set aside.

Stockpile development for scarce metal continues under the Materials Division of W.P.B., with R.F.C. financial and title control. But distribution for non-military purposes is under Civilian Supply Director Henderson. Priorities and allocations for military purposes are as hitherto under the Industry Operations Branch.

Reconstruction Finance Corp. has adopted a plan to encourage producers to speed up development of small ore deposits containing strategic and critical metals and minerals. The owner or lessee of mining property that gives reasonable promise of success may now secure a loan from the Reconstruction Finance Corp., repayable out of proceeds from production, rather than a mortgage on the mining property. These mining development loans will be made initially in amounts not in excess of $20,000. If the results of such development are favorable, additional loans up to $20,000 may be made for further development. RFC engineers will be available in mining sections to assist applicants for loans and to examine the property.

Priority Quotas—To determine the quantity of repair materials and equipment for which high priority will be granted, the W.P.B. is making a survey of all mines having serial numbers under Order P-56. It is not intended to cancel the A-1-c rating there granted; but it is likely that some sort of a limitation on the use of that very high priority will be imposed. To determine the quota permissible for each recognized company, the current survey requires data for recent periods and estimates for both the first quarter and the second quarter of 1942. On the basis of such information the priority executives in Washington will decide whether it is going to be necessary to impose restrictions, and how and where they can best be placed.

This development of further information regarding repair priorities illustrates the complexity of the Washington set-up. So many folks have been given special privileges that now it takes something super-special to get results. This is not due to abuse of the priorities system. It is simply the inevitable consequence of a growth in business and the constantly increasing scope of war effort which requires some kind of speed-up aid.

Shortest Haul—If several bidders offer a metal or mineral at identical price, it is proposed by Secretary Ickes that award of contract be made to the firm supplying the goods from a site nearest the desired point of delivery. This will mean a reduction in the transportation burden caused by government buying. This general policy may be followed in other offices, but has not yet become official.

Foreign Patents—Before an American inventor may make application for a patent in a foreign country, he must now get specific authorization from the United States Commissioner of Patents. This prohibition covers any application in a foreign country for an industrial design or model or the filing of any patent information. The Commissioner of Patents will issue such authorization only when there is no danger of disclosing information of military significance to the United States.

Make It From Inventory—Manufacturers who get orders with high preference rating are expected to make up the goods which the government wants out of the material which they have on hand. This requirement assumes that the priority for material to correspond with the order will be met as promptly as possible. Thus, manufacturer X will get back into his stockpile the metals, minerals, or other goods needed to replace those used up in prompt meeting of government orders.

New Patent Law—Despite the urgency of war matters, the President has decided that there should be a further early review of the American patent system. He has, therefore, established a National Patent Planning Commission of five members to work with the Department of Commerce on an investigation of needed modifications in the system. It is anticipated that one of the major functions of the board will be to recommend changes necessary for stimulating or aiding by patents or patent control the

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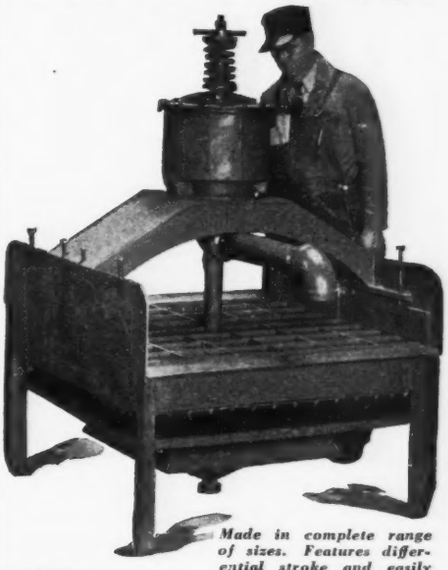

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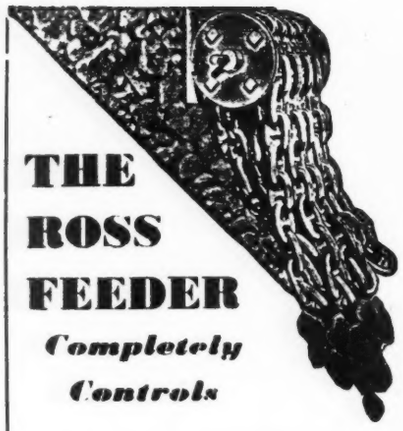

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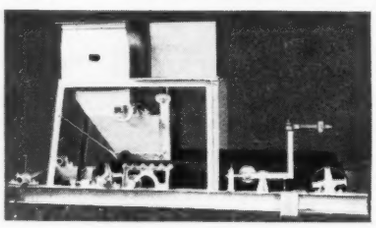

The electrically controlled Poidometer has shown unusual accuracy in handling stone, ore, and other material where there is considerable constant variation in size. It is, also, very efficient and self adjusting when the size of the material varies over a period of time. The motor operated regulating gate, controlling the feed of material, responds instantly to a change of weight on the belt scale platform. The Poidometer construction is rigid and durable—the bearings are dust tight, with alemite fittings for proper lubrication—all sensitive operating parts are fully enclosed. The conveying part of the Poidometer may be made any length up to 35 feet.

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WRITE FOR CATALOGUE #7

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Power Data—A new statistical service has been announced by the Federal Power Commission consolidating a large number of monthly and annual reports previously issued separately. Mining engineers or executives requiring regular data on energy production, consumption, and new projects may subscribe to the new coordinated statistical service at the nominal cost of $2 per year. All communications regarding the matter should be directed to the Federal Power Commission.

Nevada Manganese—Washington hears rumors of new commercial development of domestic manganese by large firms long experienced in mining and metallurgical operations. These projects may be made as an outgrowth of the semi-works experiments reported recently by the U. S. Bureau of Mines (see *E.&M.J.* October, page 78).

Property Seizure—Full authority has been given the President to take over private property, with fair and just compensation to owners, whenever national defense requires. It is anticipated that this authority will be sparingly exercised either in taking over plants or in recapturing for defense use excessive inventories of scarce materials.

To Get Twenty Billion—Washington officials are trying to figure out how to recapture about twenty billion dollars more of the national income which increased defense activity is creating. One objective is to get the money into Uncle Sam's Treasury for defense spending. The other is to reduce buying power and thus slow down inflationary movements. Most talked of as means of getting the money are huge new payroll taxes; transfer of all old-age and unemployment (Social Security) matters to the Federal Government, taking them away from the states; and various forms of forced saving. Some form of almost compulsory buying of government securities is to be expected next year. Even more certain is some increase in the Federal "take" from payrolls. Final decisions by Congress will not come until late winter or early spring.

South American Copper—To speed up copper delivery from South America, OPM is granting high priority aid to firms needing scarce materials or equipment, especially for operating, maintenance, and special repairs. Several Chilean copper enterprises are getting the benefit of priorities ranging from A-1-d to A-3, depending on the urgency of the need.

Bomb Insurance—The RFC has made preliminary plans to provide without charge insurance for individuals and companies against damage caused by enemy bombing, and perhaps other war hazards. It is planned, however, that private enterprise shall protect itself against most of its losses of this sort. The upper limit contemplated for a single property owner is so small as to be wholly inadequate for most industrial enterprises. It has not yet been decided whether the government for a fee will cover greater risks, or whether it will expect private insurance enterprise to provide that protection.

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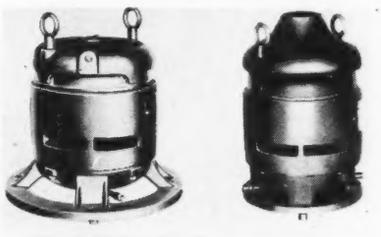
EQUIPMENT NEWS

New Motors

THREE NEW MOTORS—a vertical general-purpose polyphase motor, a vertical shielded polyphase motor (1 to 20 hp.) and a vertical shielded single-phase motor (1 to 15 hp.)—have been added to the General Electric Tri-Clad family. The shielded-type motors are especially suited to pumping applications, and the general-purpose motor is suitable for use in the machine-tool industry as well as for agitators and similar applications.



The compact, cast-iron frame and cover of the general-purpose motors are designed to give added protection to electrical parts, without adding materially to the over-all height. The use of Formex wire, new punchings and coil shapes, double-end ventilation, and balanced design are features said to contribute to long life. Accurate alignment of the motor to the driven unit is assured by machined rabbets on the stator frame and base. Bearings are of the deeply grooved type, and are incased in machined cast-iron housings. All openings in the general-purpose motor are shielded to bar the entrance of chips or other falling objects. A variety of bases makes it possible for this motor to meet many applications and mounting requirements.

The polyphase shielded-type motors are available in either solid-shaft or hollow-shaft construction; single-phase shielded-type motors are available only in solid-shaft construction. Both shielded types are for normal-thrust or high-thrust applications.

These motors are suitable for outdoor operation except where extremes of moisture, dust, or other harmful agents make the selection of fan-cooled motors more economical. All frame sizes have common mounting dimensions, making possible interchangeability of any horsepower and speed combinations, including single-phase ratings. The motors can be rotated to any one of four base positions without modification of the supporting structure.

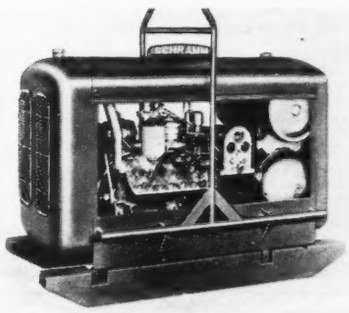
Magnet-Filter

S. G. FRANTZ Co., Inc., manufacturer of magnetic separators, 161 Grand St., New York, has developed a Permanent Magnet FerroFilter with greater capacity than any previous FerroFilter of this type.

It is designated as the PQ-6; capacity 200 G.P.M.; pipe size connection 3 in.; height 15⅝ in. It has no moving parts. The Model PQ-6 is especially adapted to removal of harmful fine iron and steel particles from circulating coolant systems of machines used in tapping, grinding, deep-hole drilling, reaming, and riffling, and also from circulating lubricating oil systems of pumps, diesel and blooming engines, rod mills, roll grinders, etc.

Semi-Portable Air Compressor

A MODEL No. 60 semi-portable air compressor with special skids and lifting bale manufactured by Schramm, Inc., West Chester, Pa., includes shackle bolt fittings attached to frame, with removable wood skids for mounting on chassis, trailer, truck, or base, and welded hand rail and lifting bale for easy handling so that compressor can be lifted by crane, hoist, or man-power for truck or mobile power installations.



The unit is said to have capacity of 60 cu.ft. of actual air delivery per minute at 100-lb. gage pressure. With a Mercury V-8 engine, four cylinders are used for power and four cylinders used for compressing air, eliminating all belts, chains, and gears or other forms of transmission. The compressor is a self-contained unit, with electric self-starting, air and fuel tanks, cooling unit, hood and doors, force-feed lubrication, en-bloc construction, positive automatic control, mechanical intake valves, low fuel consumption, and light-weight portability.

New Drifter

THE D-505 DRIFTER is the latest addition to the line of rock drills of the Ingersoll-Rand Co., 11 Broadway, New York, N. Y. It incorporates many new and improved features, and is said to be the fastest and most durable drifter ever produced by the company.

Exhaustive tests have shown that the efficiency of the D-505, based on inches drilled per cubic foot of air at 90-lb. pressure is 34 percent greater than that of I-R previous 4-in.-bore machines, and 52 percent greater at 70-lb. pressure.

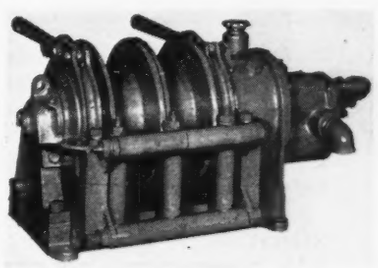
Features of the D-505 include a wall section of the fronthead 10 percent thicker than that of the previous 4-in. drifters. The shank aligner is 18 percent longer and 8 percent thicker, and an improved chuck design of heavier construction has been included. The design of the piston-stem cushion bearing permits a heavier metal section in the cylinder and furnishes better support. There is a port on each side of the cylinder—a feature which balances the piston within the cylinder.

The air to the front end of the cylinder passes directly between the ratchet and the head of the rifle bar. It is unrestricted by small ports. This assures good hole-cleaning, and aids in supplying constant lubrication to all moving parts.

The D-505 employs a sturdy rifle bar which makes possible strong rotation. The rifle bar pawls are reversible for longer life. Operators will find that the throttle handle is more readily accessible, and that it is well protected by the backhead, so that it cannot be broken easily.

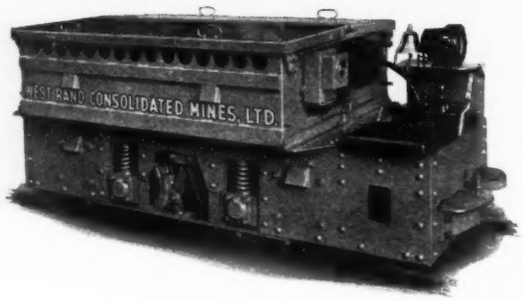
Portable Scraper Hauler

SULLIVAN MACHINERY CO., Michigan City, Ind., has developed a compact scraper hauler, S-211, suitable for small jobs or in close workings; for handling ore in preliminary rounds or sublevel drifts, short clean-up jobs in isolated workings, mucking out short crosscuts, handling waste fill, and many similar jobs formerly done by hand. This rugged portable hauler is 27 in. long and passes through a 12x14-in. opening. It weighs 250 lb., less rope guides, and is a one-man machine for most operations. Fast rope speed, 125 ft. per minute, is developed through the Sullivan patented "Turbinair" motor. Rated rope pull is 1,000 lb. but by speeding the motor and suddenly applying the clutch it momentarily pulls more than twice this load, an advantage when scraping large boulders. The S-211 can be equipped with either Turbinair or electric motor.



(*Continued on page* 112)

the practical side of mining—**BY ATLAS**



ATLAS TYPE "A" . . .

For low cost, trouble free locomotive service on the main line, specify the Atlas Type "A" Mine Locomotive. It meets all the requirements for locomotives in today's busy mining industry. Complete reliability because of a rugged, heavy duty construction allowing you to maintain top production schedules. The Type "A" is equipped with the Atlas double-reduction Spur Gear Drive. Further information, on request.

THE ATLAS CAR & MFG. CO.
★ **CLEVELAND, OHIO, U. S. A.** ★

RESULTS NOW!

No **IF's, AND's *or* BUT's!**

WITH NICHOLS HERRESHOFF FURNACES

THE PRODUCTION of vital metals so urgent today, can be speeded through the use of Nichols Herreshoff Furnaces. Their proven performance, flexibility of design, compactness, low power consumption and simplicity of operation make them time and money savers for increasing the output of needed metals.

Over fifty years of proven performance in the **DRYING • ROASTING • CALCINING** of many materials is the reason why these furnaces are so extensively used in the metallurgical and chemical industries.

Bulletin No. 206 describes these furnaces and will be sent upon request.

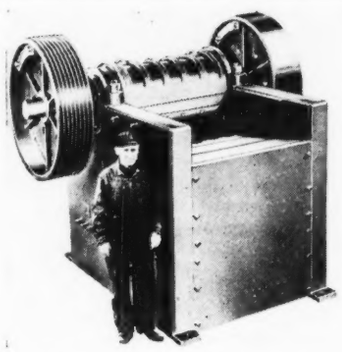
NICHOLS
ENGINEERING & NERCO RESEARCH CORP.
60 WALL TOWER NEW YORK, N. Y.

▸ EQUIPMENT NEWS

Arc-Welded Truck Body

IN THE CONSTRUCTION of truck bodies to haul iron ore on the northern iron ranges, National Steel Products Co., Kansas City, Mo., used Lincoln arc welding to gain strength and economy. As shown in the accompanying illustration the truck bodies are 14 ft. long, 8 ft. wide, and 38 in. deep, built of quarter-

inch plate. The bottom is double and the inside plate is ½ in. thick. Ribs are 3 in. I-beams and the main channels are 6 in. High-tensile steel is used, reducing the weight to 7,700 lb. and giving a pay load of 10 cu.yd. of ore weighing about 22 tons. It is estimated that conventional construction with ordinary mild steel would have involved an increased cost of more than 30 percent.



Modern materials used in the construction of this 30x42-in. new jaw crusher made by the Pioneer Engineering Works, Inc., Minneapolis, Minn., are said to save more than 50 percent of the weight of the unit compared to other types of jaw crushers of similar size

New Dynamite Cartridge

A NEW DYNAMITE CARTRIDGE which will expand under tamping to fill the bore hole and concentrate the charge has been developed by the explosives department of Hercules Powder Co., Wilmington, Del. The new cartridge, called "Tamptite," eliminates the necessity of slitting cartridges and permits concentration of a charge within the hole with

little or no spillage of powder. When tamped in a borehole, the cartridge does not open as a slit cartridge does, but unwraps slightly as the cartridge expands to fill the hole. Splitting along the perforated line permits the dynamite to be telescoped to a shortened length while it expands to the diameter of the hole. All of the Hercules brands and grades commonly used in mining, quarrying, and underground work, in sizes up to 1¾ in. in diameter, are available in the new shell.

BULLETINS

Portable Electric Tool. Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Catalog 37 describes and illustrates the company's Thor portable electric tools and accessories. Pp. 64.

Centrifugal Pump. A. R. Wilfley & Sons, Inc., Denver, Colo. Bulletin E-4320 describes and illustrates the manufacturer's plastic lined acid centrifugal pumps. Pp. 4.

Ignitron Rectifiers. Westinghouse Electrical & Mfg. Co., East Pittsburgh, Pa. Booklet B-3024 describes design, construction and operation of the manufacturer's 250- to 900-volt range ignitron rectifiers. Pp. 40.

Diaphragm Slurry Pump. Oliver United Filters, Inc., 33 W. 42 St., New York, N. Y. Bulletin 307 describes and illustrates the company's O-D-S pump that has the feature of being actuated without mechanical linkage or other mechanical connections to the diaphragm. Pp. 4.

Motors. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo. Bulletin MV-183 describes and illustrates the company's line of single-phase, direct-current and small polyphase motors. Pp. 34.

Refractories. General Refractories Co., Philadelphia, Pa., has issued a booklet called "Complete Refractories Service," that describes the various types and uses of refactory bricks. Pp. 71.

Open End V-Belting. The B. F. Goodrich Co., Akron, Ohio. Leaflet 2186 describes features of the company's open end V-belting. Pp. 2. **Rubber Putty.** Leaflet 9765 describes properties and uses of its Plastikon rubber putty. Pp. 2.

Rotary Kilns. Kennedy-Van Saun Mfg. & Eng. Corp., 2 Park Ave., New York, N. Y. Bulletin 770 contains the latest contributions to rotary kiln design and describes and illustrates the manufacturer's rotary kilns for lime dolomite, roasting and sintering ore and for drying and preheating. Pp. 16.

Magnets. Dings Magnetic Separator Co., Milwaukee, Wis. Catalog 301 describes and illustrates features of the company's rectangular suspended magnet designed for use above belt conveyors to remove tramp iron from ore-dressing plants and other industries.

Jaw Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa. Bulletin 2105 describes and illustrates features of the company's Type H Blake jaw crushers. Parts listed and tables of capacities together with general instructions for assembly and operation are included. Pp. 13. **Multi Stage Reduction Crusher.** Bulletin 1113 contains comprehensive information about the manufacturer's latest crushing unit called the Multi Stage fine-reduction crusher with head diameters from 1 ft. 8 in. to 4 ft. Pp. 25. **Rotary Kilns, Coolers and Dryers.** Bulletin 115 is a profusely illustrated bulletin showing installations and describing features of the company's kilns, coolers, and dryers. Pp. 21.

Pebble and Ball Mills. Paul O. Abbe, Little Falls, N. J. Catalog T is the company's most complete catalog on the subject of ball mills and pebble mills for grinding and mixing dry and wet products in batch or continuous operation. It contains data on grinding principles and mill construction and lists various types of pebble grinding media. The book is well illustrated. Pp. 54.

Belt Conveyors. Chain Belt Co., Milwaukee, Wis. Bulletin 410 contains information and pictorial descriptions of the manufacturer's belt and apron conveyors and bucket elevators. Pp. 16.

Chain Feeders. Ross Screen & Feeder Co., 19 Rector St., New York, N. Y. Catalog X-2 is a comprehensive bulletin describing and illustrating the manufac-

Screening Facts
NOT JUST CLAIMS

● Preparation and concentration plants throughout the Mining Industry all agree that their screening equipment is the heart of their plant and to produce profits, must function efficiently. Simplicity Gyrating Screens do fulfill this requirement. The best proof of this fact is that over 1300 operating plants, each having from one to forty-six Simplicity machines, are on our list of known users.

One large producer, operating 15 plants in five different states, purchased their first Simplicity screens in 1929, and up to December 1st, 1941, had purchased a total of 104 Simplicity Gyrating Screens. Twenty-two of these units were purchased during 1941, with the bulk of them going into two of their newest and largest plants. Their purchases have ranged from 2'x3' singles to 5'x12' triples. During twelve years of operating Simplicity screens under all conditions, their records show a remarkably low average yearly maintenance cost per machine.

For Screening Facts, ask your Simplicity Representative, or write for our descriptive bulletin

SIMPLICITY ENGINEERING COMPANY
DURAND, MICHIGAN

Just say:
"Information, please"

whenever you need products or services not advertised in a particular issue of this magazine.

Each issue is only part of the complete service we are organized and glad to render to reader and advertiser, alike. We want you to consider Engineering & Mining Journal your primary source of information in this field.

Departmental Staff
ENGINEERING & MINING JOURNAL
330 West 42nd St., New York

turer's chain and drop-bar feeders, and two-roll grizzlies. Crushing-plant layout drawings with specifications of the company's equipment are also included. Pp. 36.

Pumps. Denver Equipment Co., Denver, Colo. Bulletin P6-D describes and illustrates features of the company's line of adjustable stroke diaphragm pumps. Pp. 4. **Jaw Crusher.** Bulletin C12-B1 describes and illustrates the manufacturer's anti-friction bearing type jaw crushers. Pp. 4. **Rotary Filter.** Bulletin F8-B1 illustrates and gives specifications of the company's rotary filter with drum cast in one piece. Pp. 4.

Belt Conveyor Scales. Fairbanks, Morse & Co., Chicago, Ill. Publication ASB 100.9 describes and illustrates features of the company's weighing machines for ore and materials on conveyor belts.

Mechanical Loaders. The Eimco Corp., Salt Lake City, Utah. Bulletin 107 describes the driving of the Carlton and Elton tunnels and the part played by the manufacturer's Eimco-Finlay loaders. Pp. 8.

Dry Concentration. Sutton, Steele & Steele, Inc., Dallas, Tex. Folder describes the company's Air-Float Separator for dry concentration of ore, minerals, and other industrial materials. Pp. 4.

Electric Heating Units and Controls. Westinghouse Electric & Mfg. Co., Heating Section, Mansfield, Ohio. Catalog 28-000 describes and illustrates the manufacturer's line of electric heating units and controls for industrial application involving the heating of liquids, solids, or air. Several pages are given to data on how to select industrial heaters. Pp. 39.

New Book on Welding Training. Prepared to assist instructors in planning courses for the training of oxy-acetylene welding and cutting operation is the purpose of this book published by the International Acetylene Association, 30 East 42d St., New York, N. Y. Pp. 88. Paper bound copies are 25c.

Truck Operators Handbook. B. F. Goodrich Co., Akron, Ohio, announces a small pocket booklet on truck, trailers, and tractor tires and their care. A special section is entitled "Factors Governing Truck Tire Service." Pp. 97.

Vibrating Screen. Robins Conveying Belt Co. Passaic, N. J. Bulletin 118 describes and illustrates features of the company's new Style M vibrating screen. Pp. 4.

Switching Engine. General Electric Co., Schenectady, N. Y. Bulletin GEA-3666 describes and illustrates the company's 45-ton diesel electric switching engine. Pp. 15. **Electric Strain Gages.** GEA-3673 describes electric gages available for measuring mechanical strains. Pp. 8.

Possible Alternates for Alloy Steels. American Iron and Steel Institute, 350 5th Ave., New York, N. Y. The Institute has published a booklet entitled "Possible Alternates for Nickel, Chromium and Chromium-Nickel Construction Alloy Steels." Pp. 143. Price 50c.

Gravity Induction Separator. Sterns Magnetic Mfg. Co., Milwaukee, Wis. Bulletin 701 illustrates and describes the manufacturer's Type K gravity induction separator, particularly suited for treating materials of highly reluctant magnetic value.

Vibrating Screen. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin B6151A describes and illustrates features of the manufacturer's new Ripl-Flo vibrating screen. Installation drawings and specifications are given. Pp. 15. **Speed Changers.** Bulletin B6013A contains diagrams, operating data and selection tables on the company's Vari-Pitch Speed Changer units in sizes handling from 1½ to 75 hp. Pp. 17.

Prime Pump. Chain Belt Co., Milwaukee, Wis. Bulletin 400 is a comprehensive descriptive bulletin telling features of the manufacturer's "Rex Jr." 3,000 g.p.h., 1-hp., gasoline-driven portable pump weighing 57 lb. Important engineering and installation data are also given. Pp. 22.

V-Belt Drives. L. H. Gilmer Co., Tacony, Philadelphia, Pa. The company has prepared a thorough bulletin (Form 325) describing its complete drive service on V-belts, streamlined V-belting for connector sheaves, including pulleys for V to flat drives. Multiple and fractional horsepower drives are also fully covered, together with tables of standard belts and sheaves and general engineering data. Pp. 99.

Industrial Trailers. Electric Wheel Co., Quincy, Ill. The company has issued a group of bound bulletins describing and illustrating its various types of small- and medium-sized trailer floor and hand trucks for various industrial uses.

Earth-Moving Equipment. La Plante-Choate Mfg. Co., Cedar Rapids, Iowa. Form A-265-675 describes and illustrates in color the manufacturer's earth moving, clearing, and snow-removal equipment.

Mine Rig for Drills. Cleveland Rock Drill Co., 3734 East 78th St., Cleveland, Ohio. Bulletin 131 describes and illustrates the manufacturer's new mine rig for supporting rock drills at the face without the use of a column block or wedges. Pp. 4.

Loading Machine. Athey Truss Wheel Co., 5631 West 65th St., Chicago, Ill. Booklet describes and illustrates the company's Mobiloader used for general excavation, loading ores and other material handling applications.

Portable and Stationary Compressors. Schramm, Inc., West Chester, Pa. Bulletin 4260 is entitled "Air for Defense," illustrating the application of the manufacturer's portable and stationary air compressors for such use as air-raid and fire sirens, rescue and fire trucks, power plant stand-by, and other uses. Pp. 4.

Rotary Switches. Roller-Smith Co., Bethlehem, Pa. Catalog 7140 describes and illustrates features of the company's rotary type control, transfer and auxiliary switches. Pp. 15.

Welding Flux Chart. Krembs & Co., 669 W. Ohio St., Chicago, have published a chart answering over 400 fluxing questions relating to welding, brazing, and soldering. Complimentary copy to metal-working concerns applying on their letterheads.

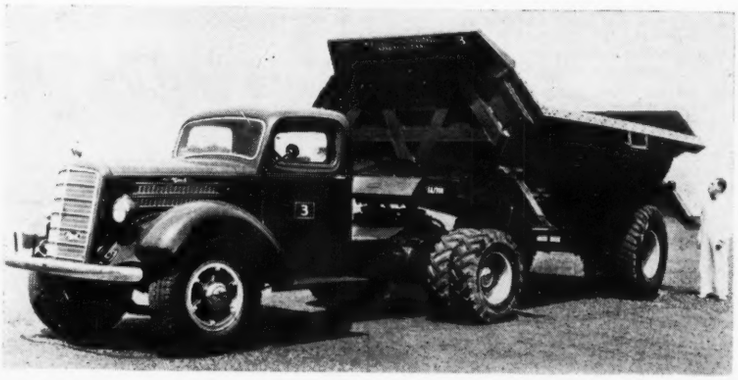
Graphic Instruments. Esterline-Angus Co., Inc., Indianapolis, Ind., has published a brochure, "Solving Industrial Crimes, Case No. 28," showing use of instruments to prevent waste of power.

The Merrick Weightometer provides a continuous, automatic, accurate weight record while material is in motion on conveyor. It weighs without interrupting conveyor service.

Applicable to any size belt conveyor, horizontal or inclined. An accurate and dependable means of keeping constant check on production.

Write for Bulletin 375.

MERRICK SCALE MFG. CO.
PASSAIC, NEW JERSEY U.S.A.



This large truck trailer unit, built by the Easton Car & Construction Co., Easton, Pa., has a capacity of 22 to 25 tons. Dumping is afforded either by hydraulic body hoists or by fixed external hoists.

TRI-VIBE GIVES TRIPLE EFFECTIVENESS
WITH ONLY ½ H.P.

Greater Capacity and Uniformity
Greater Fine Screening Efficiency
Greater Operating Economy

Tri-Vibe triple powers the free swinging jacket . . . gives better distribution of vibratory action and prevents blinding.

The Leahy HEAVY DUTY Vibrating Screen

Write for Bulletin No. 14-H

THE DEISTER CONCENTRATOR COMPANY
The Original Deister Co. Est. 1906
915 GLASGOW AVE. FORT WAYNE, IND.

Diesel Engines. Caterpillar Tractor Co., Peoria, Ill., has published a new booklet entitled "Caterpillar Diesel . . . On Guard," illustrating use of these engines in the victory program. Ask for Form 7283.

Speed Indicator. Reeves Pulley Co., Columbus, Ind., has developed a new type electric remote-speed indicator for use with Reeves variable-speed control equipment. It is described in Bulletin G-427.

INDUSTRIAL NOTES

The Seamless Steel Tube Institute, Gulf Building, Pittsburgh, Pa., announces the establishment of a new service whereby purchasers may obtain information on the availability of various grades and sizes of seamless steel tubing for new or special wartime requirements.

Bethlehem Foundry & Machine Co., Bethlehem, Pa., has been awarded the Navy "E" and Bureau of Ordnance Flag for outstanding achievement.

Appointment of **J. Rogers Davis** as "Supervisor of Branches," newly created office of the **Chicago Pneumatic Tool Co.,** was announced recently by **H. Arnold Jackson,** president of the company, at its headquarters, 6 East 44th St. Mr. Davis will standardize sales office procedure and coordinate sales plans and quotas with branch and division managers.

Cummins Engine Co., Columbus, Ind., manufacturers of Cummins diesel engines for automotive, industrial, and marine service, has named **Harry K. Smyth** as export-eastern regional manager. He will supervise all sales activities in these two territories, with offices in the Chrysler Building, New York City.

The **Diamond Drill Core Drill Manufacturers Association** announces that the effective date for new production of diamond core drill fittings (new EXT and AXT sizes), according to Commercial Standard CS17-42, is extended from Jan. 1, 1942, to Jan. 1, 1943.

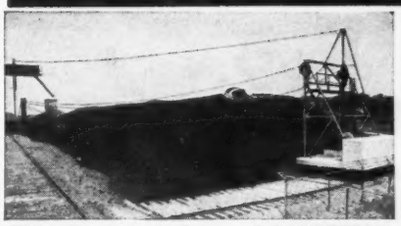
Markley Dust-Control System, Inc., announces moving to its new plant at 431 Fayette Ave., Mamaroneck, N. Y.

Worthington Pump and Machinery Corp. has announced the appointment of Joseph T. Wright as manager of the Compressor and Tool Division at its Holyoke, Mass., works.

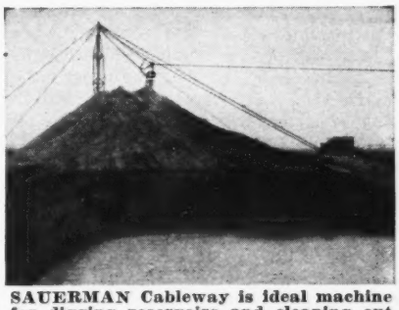
General Electric Co., Schenectady, N. Y., has produced six one-reel, all-color, sound-motion pictures as an aid to training welding operators. The films are titled "The Inside of Arc Welding." Information on obtaining the pictures will be supplied by the Visual Instruction Section, Publicity Department, General Electric Co., Schenectady, N. Y.

Carboloy Co., Inc., Detroit, announces the appointment of William Harris, 2667 Beverly St., Highland Park, Salt Lake City, Utah, as sales representative and service engineer for its Sinta-Set products, primarily Sinta-Set core bits, in Washington, Oregon, California, Colorado, Idaho, Montana, Wyoming, Nevada, Utah, North Dakota, and South Dakota. Sand blast equipment for reconditioning Sinta-Set core bits is being installed by Mr. Harris in Salt Lake City headquarters. It is understood that for the present, at least, Sinta-Set core bits will be reconditioned on this equipment without charge.

Sauerman LONG RANGE MACHINES



This shows typical use of SAUERMAN Scraper for storing and reclaiming large tonnage of coal, ore and like materials.



SAUERMAN Cableway is ideal machine for digging reservoirs and cleaning out ponds.

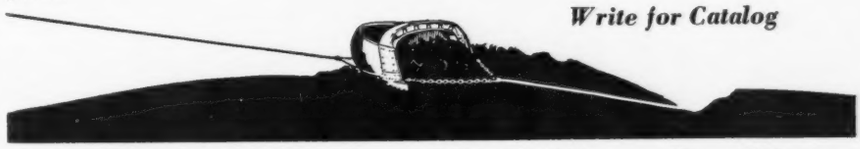
Handle Materials at real low cost

On jobs where materials are to be moved distances of several hundred feet or more, a SAUERMAN Drag Scraper or Cableway is a great money-saver because it will pick up, haul and place the materials without the help of other equipment.

First cost of a SAUERMAN machine is reasonable, maintenance expense is light, and the simplicity of operation permits easy one-man control of even the largest installation.

Moreover this equipment is very flexible and is readily adapted to meet any new and difficult working conditions. Sizes range from small portable units designed for cheap handling of a small hourly tonnage of loose materials up to powerful machines that will move as much as 1,000 tons per hour of the toughest materials.

Write for Catalog



SAUERMAN BROS., Inc., 584 S. Clinton St., Chicago

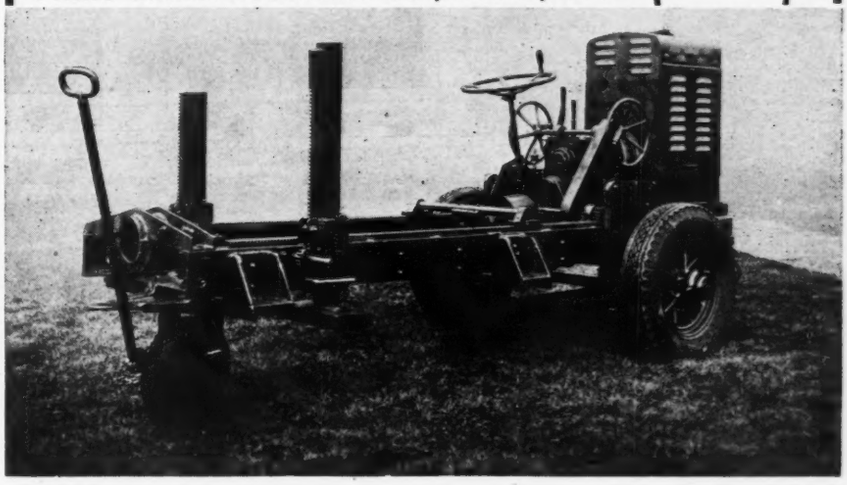
PARMANCO HORIZONTAL DRILLING MACHINES

Made good in IRON RANGE *and Coal Fields*

Drill up to 6" holes, 60 feet in depth this simple, easy way. Just pull one pin to remove front wheel and the PARMANCO is ready to begin work. Operators have the drilling speed always under control so that drilling steel is not damaged. Clean holes always drilled. The augers have special drill heads for tough wear—they really stand up under unusual conditions and you are assured of longer wear. Write for full details.

- Only 15 seconds to disconnect the drill and hitch up the motor for traction on wheels to move to any location.

PARIS MANUFACTURING CO., PARIS, ILL.



NEW BOOKS

SCIENCE AND PRACTICE OF WELDING. *By A. C. Davies, Cambridge University Press Department, Macmillan Company, 60 Fifth Ave., New York, Pp. 436. Price $2.25.*

TREATMENT OF THE SUBJECT is accomplished in eight chapters as follows: Chemistry applied to welding; fluxes; metallurgy; oxyacetylene welding; electric arc welding; gas cutting of iron and steel; inspection and testing of welds; additional processes of welding; engineering drawing. An appendix contains questions on welding science and practice.

PHYSICS FOR THE ENGINEER. *By Sir Ambrose Fleming. Chemical Publishing Co., Brooklyn, N. Y. Pp. 232. Price $3.*

THE AUTHOR has made an effort to provide a practical summary of such portions of physical science as he deems necessary for the engineer, on the assumption, apparently, that it will serve the latter for review. A brief survey of the book and its contents indicates that the author is thinking primarily of the electrical engineer. Nevertheless, the book should be generally useful.

▼ ▼ ▼

PUBLICATIONS

RECEIVED

"Manganese in Oregon." By F. W. Libbey, J. E. Allen, R. C. Treasher, and H. K. Lancaster. Bulletin 17, Oregon Department of Geology and Mineral Industries. Portland, Ore. Price 45c. Pp. 78.

"Steel Products Manual." Secs. 8, 10, and 15, revised and dealing respectfully with hot-rolled carbon-steel bars (62 pp.), alloy steels (45 pp.), and hot-rolled carbon-steel wire rods (40 pp.). American Iron and Steel Institute, 350 Fifth Ave., New York.

"East Tennessee Manganese Resources." By Stanley O. Reichert. Bulletin 50, Tennessee Division of Geology, edited by George I. Whitlatch. This covers geology of ore occurrence and current mining activities (140 mines or prospects). Division of Geology, Nashville, Tenn. Pp. 204, plus index and Maps.

"Mining Industry of Idaho, 1941." Forty-third annual report of Inspector of Mines (Arthur Campbell), Boise, Idaho. Pp. 274.

"Crow Wing County, Minnesota," Annual report for 1941 of Mine Inspector (Oliver Stark), Crosby, Minn. Pp. 14, plus map.

"Standardization Activities of National Technical and Trade Organizations." By Robert A. Martino. National Bureau of Standards. For sale by Superintendent of Documents, Washington, D. C. Pp. 288. Price 75c.

Itasca County, Minnesota. Annual Report of Inspector of Mines (J. A. Beecroft), 1941. Keewatin, Minn. (The mines covered are on the Mesabi). Pp. 22.

Quebec. The Mining Industry of the Province in 1940. Issued by Quebec Bureau of Mines, Quebec, P. Q. Pp. 109.

"Matapedia Lake Area." Parts of the counties of Matane, Matapedia and Rimouski. By E. Aubert de la Rüe. Geological Report No. 9. Quebec Bureau of Mines, Quebec, P. Q. Pp. 40, plus maps.

Engineering as a Career—A message to young men, teachers, parents. A 36-page brochure prepared by the Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y. Price 10c per copy; $7.50 per 100.

Transactions of Institution of Mining and Metallurgy. Vol. XLIX, 1940. Published by the Institution, Salisbury House, Finsbury Circus, London, E. C. 2.

Taxes and Duties on the Mining Industry in Bolivia (Spanish). Banco Minero de Bolivia, La Paz. Pp. 189.

Nevada's Common Minerals. University of Nevada Bulletin; Geology and Mining Series No. 36, Reno, Nev. Pp. 110.

Powder Metallurgy. A review of Its Literature, Colorado School of Mines *Quarterly,* October, 1941, Golden, Colo. Pp. 55. Price 50c.

Chamber of Mines, Rhodesia. Annual Report for 1940. Bulawayo, Southern Rhodesia. Pp. 46.

The Hopper. Published in the office of the Oklahoma Geological Survey, Norman, Okla. Contains an article on "Adaptability of Oklahoma's Mineral Resources," by A. L. Burwell, chemical engineer. Pp. 10.

Geology, Selected Papers in. Contains three reprints. "Place of Observational Geology, Past and Present," by Benjamin L. Miller. "Recurrent Paleozoic Continental Facies in Pennsylvania," by Bradford Willard. "Key for Recognition of Physiographic Provinces From Topographic Maps," by Lawrence Whitcomb. Lehigh University Publications, Nov., 1941. Bethlehem, Pa.

Mine Safety Conference. Proceedings of 18th Mine Safety Conference, Lake Superior Mining Section, Duluth, Minn., June 26–27, 1941, pp. 146.

Metal- and Nonmetal-Mine Accidents in the United States, 1939 (excluding coal mines). Bureau of Mines Bulletin 440. Pp. 52. For sale by Superintendent of Documents, Washington, D. C. Price 10 cents.

Hot-Tinning Difficult Mild Steels. By W. E. Hoare and H. Plummer. Publication No. 107, Tin Research Institute, 505 King Ave., Columbus, Ohio. Pp. 28.

The U. S. Geological Survey has issued the following (for sale by Superintendent of Documents, Washington, D. C., at stated prices):

"Tungsten Deposits in Sierra Nevada, Near Bishop, Calif." By D. M. Lemmon. Bulletin 931-E. Pp. 79 to 104, plus maps. Price 35c.

"Chromite Deposits of Kenai Peninsula, Alaska." By P. W. Guild. Bulletin 931-G. Pp. 139 to 175, plus maps. Price 50c.

"Nickel Deposit Near Riddle, Douglas County, Oregon." By W. T. Pecora and S. W. Hobbs. Bulletin 931-I. Pp. 205 to 226. Price 20c.

"Tin Deposits of Northern Lander County, Nevada." By Carl Fries, Jr. Bulletin 931-L. Pp. 279 to 294. Price 20c.

"Alkalic Rocks of Iron Hill, Gunnison County, Colorado." By E. S. Larsen. Professional Paper 197-A. Pp. 1 to 64 plus map. Price 40c.

"Nickel-Gold Deposit Near Mount Vernon, Skagit County, Washington." By S. W. Hobbs and W. T. Pecora. Bulletin 931-D. Pp. 57–78, plus map. Price 15c.

"Geology and Biology of North Atlantic Deep-Sea Cores, Part 4—Ostracoda." By W. L. Tressler. Professional Paper 196-C. Pp. 95–103. Price 15c.

"Montevallo-Columbiana Folio, Alabama", Geologic Atlas of the United States. Description of Montevallo and Columbiana Quadrangles by Charles Butts. This area is mainly in Shelby, Bibb and Chilton Counties, between the Coosa and Cahaba rivers, in north-central Alabama. The mineral resources of the quadrangles include coal, iron, dolomite, limestone, marble, clay, and building stone. The iron ore consists of limonite and hematite. No price is cited for the folio.

"Geology and Ore Deposits of Leadville Mining District, Colorado" (with maps). Professional Paper No. 148. The Survey states in a circular offering this paper that it should be of value to all mining geologists and students of economic geology. Sold by the Superintendent of Documents, Washington, D. C. Price $2.50.

Bureau of Mines, Washington, D. C., has issued the following (no charge is made):

"Mercury Poisoning as a Mining Hazard." By S. J. Davenport and D. Harrington. I. C. 7180. Pp. 27.

"Marketing Feldspar." By R. W. Metcalf. I. C. 7184. Pp. 13.

"Occurrences and Uses of Dolomite in the United States." By S. F. Colby. I. C. 7192. Pp. 21.

"Permissible Blasting Units." By L. C. Ilsley and A. B. Hooker. R. I. 3593. Pp. 14.

"Safe Opening and Determination of Construction of Detonators." By R. L. Grant and A. B. Coates. R. I. 3594. Pp. 16.

"Practical Fire-Sensitivity of Liquid-Oxygen Explosives Treated With Fire-Retardants." By A. R. T. Denues. R. I. 3605. Pp. 6.

"Annual Report of Mining Division, Fiscal Year 1941." By C. F. Jackson. R. I. 3596. Pp. 47.

"Bauxite Resources of the United States." By J. R. Thoenen and E. F. Burchard. R. I. 3598. Pp. 42.

"Report of Nonmetals Division." By O. C. Ralston and A. George Stern. R. I. 3599. Pp. 33.

"Status of Safety in Mining." By D. Harrington. I. C. 7181. Pp. 32.

"Accident Experience at Pebble-Phosplate Operations in Florida 1930–40." By F. E. Cash. I. C. 7186. Pp. 15.

"Prevention of Premature Shots During Springing of Deep Drill Holes in Quarries and Open-Pit Workings." By D. Harrington and C. W. Owings. I. C. 7191. Pp. 8.

"Concentration of Manganese Ores From Drum Mountain District, Utah." By S. R. Zimmerley, J. D. Vincent, and C. H. Schack, R. I. 3606. Pp. 12.

"Recovery of Manganese From Chamberlain Nodules by Ryerson Modification of Sulphur Dioxide Leaching Process." R. I. 3609. By C. E. Wood, C. L. Wallfred, E. P. Barrett, L. J. Reader, S. I. Ginsberg, W. F. Wyman, and R. L. Evans. R. I. 3609. Pp. 30.

"Concentration of Manganese Nodules from Chamberlain, S. D." By F. D. DeVaney, S. M. Shelton, and F. D. Lamb. R. I. 3613. Pp. 21.

"Beneficiation of Manganese Wad Ores from Chinn Property, Batesville, Ark." By S. M. Shelton, M. M. Fine and J. D. Bardill. R. I. 3614. Pp. 18.

"Concentration of Manganese Ores from Little Florida Mountains, Luna County, N. M." By F. D. DeVaney, M. M. Fine, and S. M. Shelton. R. I. 3620. Pp. 9.

"Concentration of Manganese-Bearing Ore from Dobbins Mine, Cartersville, Ga." By T. L. Johnston, M. M. Fine, and S. M. Shelton. R. I. 3608. Pp. 32.

"Beneficiation of Alunite." By Alton Gabriel and John Dasher." R. I. 3610. Pp. 20.

I. C. 7177. "Marketing Graphite." Pp. 12.

I. C. 7182. "Review of Literature on Conditioning Air for Advancement of Health and Safety in Mines, Part II. Need for Air Conditioning Indicated by Physical Quality of Underground Air." Pp. 104.

I. C. 7183. "Dust-Explosion Hazards From Certain Powdered Metals." Pp. 7.

R. I. 3580. "Electrolytic Manganese and Its Alloys." Pp. 58.

R. I. 3584. "Diesel Engines Underground. III—Effect on Exhaust-Gas Composition of Operating Engines in Mixtures of Normal Air and Natural Gas." Pp. 50.

R. I. 3586. "Preliminary Report on the Flotation of Bauxite." Pp. 26.

Foreign Minerals Quarterly, October, 1941. "Mineral Resources, Production and Trade of China." Pp. 31.

Concentrating Manganese Ores From Drum Mountain District

AS A RESULT of drilling done by the Mining Division of the U. S. Bureau of Mines, large amounts of manganese ores have been blocked out in the Drum Mountain district, Utah. The ores, as mined, would not be acceptable for making ferromanganese, and this investigation was made to determine their amenability to concentration by ore dressing and the amount of ferrograde manganese that could be recovered. Inasmuch as the orebodies are not uniform, the ore dressing was done on various types of ore, usually obtained in 1- or 2-ton lots. These represented high-, medium-, and low-grade manganese carbonate ores from the Staats property and one type of black-oxide manganese ore from the adjoining Ward lease.

Concentration of the Staats ore is of particular interest because the ore represents one of the few large bodies in the United States wherein manganese occurs as the carbonate, rhodochrosite. In general, for ores of like manganese content the rhodochrosite type is the most desirable for producing ferrograde manganese by milling and sintering or nodulizing.

Ore-dressing work on Drum Mountain ores is still in progress. Data herein show that all lots investigated were found amenable to concentration by standard ore-dressing methods, and ferrograde manganese was made by sintering the concentrates. The phosphorus and iron contents of some sintered concentrates were marginal. If concentrates too high in iron and phosphorus were produced, they could be corrected by mixing with concentrates from other Western manganese ores low in phosphorus and iron.

Ores—Three lots of Drum Mountain ore were produced for ore-dressing study. One 2-ton lot represents the black-oxide manganese ores. Another consisted of 2 tons of selected manganese-carbonate ore and 1 ton of rejected waste from sorting the carbonate ore. The third lot consisted of 1 ton of low-grade carbonate ore representing a 25-ft. bed. The oxide manganese ore occurs as the altered outcrop of the underlying primary carbonate ore. The carbonate is a replacement of flatly dipping limestone beds parted by seams and lenses of claylike gangue. In parts the carbonate ore occurs as nodules and stringers in beds of this gangue, whereas in other parts only small seams of gangue separate successive beds of high-grade material.

Experimental work has been done on (1) the selected high-grade carbonate ore, (2) a reconstructed medium-grade ore sample of two parts of selected carbonate ore and three parts of rejected waste, (3) the low-grade carbonate ore, and (4) the mine-run black oxide ore. Chemical analysis of each of these lots of ore as used for the concentration experiments is given in Table I.

High-grade, Sorted, Carbonate Ore—This lot represents the best grade

Table I—Analysis of Ores

Type of Ore	Mn	Insol.	SiO_2	Al_2O_3	Fe	CaO	Zn	P
Selected carbonate ore	33.8	8.3	4.1	4.0	4.5	3.7	No	0.092
Composite, medium-grade, carbonate ore	22.9	25.3	13.7	11.3	6.8	2.6	No	0.201
Low-grade carbonate ore	14.9	47.5	28.6	17.7	4.4	2.7	No	0.120
Black oxide ore	28.3	28.8	23.2	7.4	7.2	2.2	No	0.229

Table II—Results of Sintering

Product	Assay, Percent					
	Mn	SiO_2	Fe	Al_2O_3	P	Zn
Carbonate ore sintered directly	48.0	5.6	6.8	4.3	0.135	No
Deslimed carbonate ore, minus-10-mesh sands	50.3	4.2	6.8	3.3	0.110	No
	Min.	Max.	Max.	Max.	Max.	Max.
Specifications, Grade B, ferro-grade manganese	48.0	10.0	7.0	6.0	0.18	1.0

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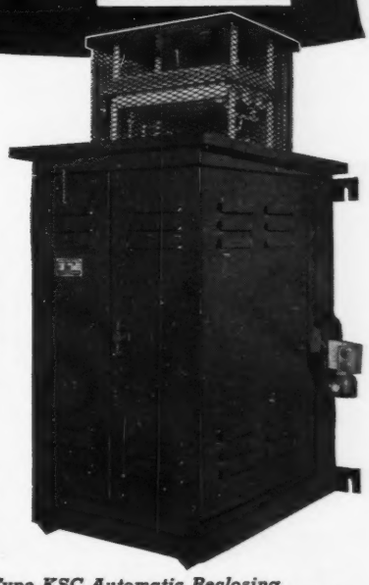

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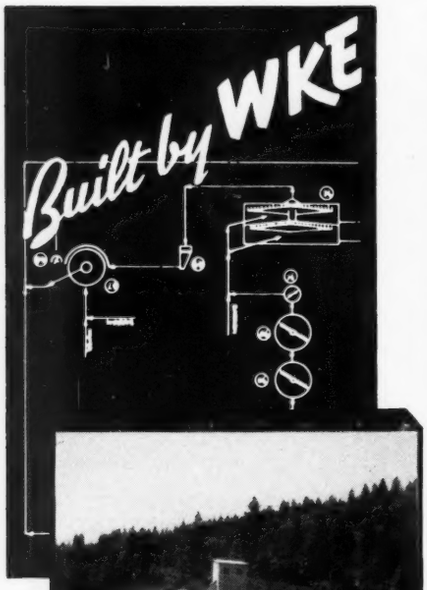

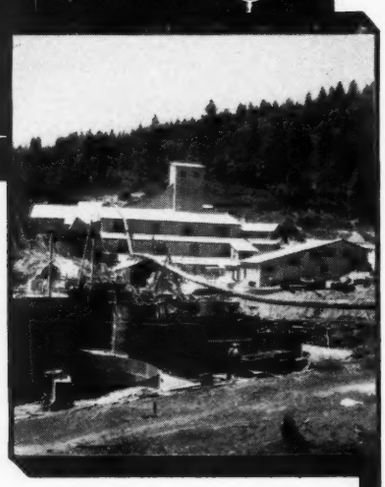

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obtainable by selective mining and sorting. A gray, impure rhodochrosite that contains varying amounts of chemically combined calcium and iron is the principal manganese mineral. Small amounts of iron sulphides and a kaolinic gouge are the chief gangue constituents. Although this ore, when sintered directly, is a marginal ferrograde product, several experiments were made to determine the extent to which the gouge and iron sulphides could be discarded.

1. Washing and Desliming—By crushing to minus-10-mesh and washing the primary slimes from the sands, 30 percent of the insoluble gangue was discarded and 96.6 percent of the manganese remained. Table III gives chemical analyses of the products made by sintering the ore and by sintering the sand product after crushing and washing.

Specifications for ferrograde manganese require that 87.5 percent be coarser than 20 mesh. Therefore, fine-sized material, such as table and flotation concentrates, must be nodulized or sintered. Sintering concentrates the manganese further, due to loss of oxygen and other constituents during heat-treatment. Impurities such as silica, iron, alumina, and phosphorus are also concentrated by sintering. Sintering was done to determine the chemical composition of the final product, and no study was made of the physical nature of the sinter.

2. Flotation of Iron Sulphides—A sample of ore was crushed to minus 10 mesh, ground to minus 100 mesh, and pulped to 25 percent solids in a mechanically agitated flotation cell. The iron sulphides, largely pyrite, were floated, using a total of 0.20 lb. of ethyl xanthate and 0.40 lb. of Avirol 80 per ton of ore; the three consecutive concentrates were kept separate for comparison. Avirol 80, in addition to acting as a frother, collected and floated some of the low-grade slime present in the ground ore. The results are given in Table III, and analysis of the sintered manganese product is given in Table IV.

Results given in Tables III and IV show that the pyrite, representing 28 percent of the iron, was floated and discarded with a loss of only 7 percent of the manganese. Flotation of the last of the pyrite from the ore was not very selective, as shown by the composition of concentrates 2 and 3; however, the manganese tailing was free of pyrite. The iron tenor of the pyrite-free tailing was 3.8 percent, which represents the extent to which iron was present as an impurity in the gray rhodochrosite in the high-grade ore. The pyrite was more difficult to float than that usually occurring in siliceous ores; however, it appears that if pyrite occurs more copiously in other parts of the carbonate deposit it can be removed by flotation. Although Avirol 80 was used here, the

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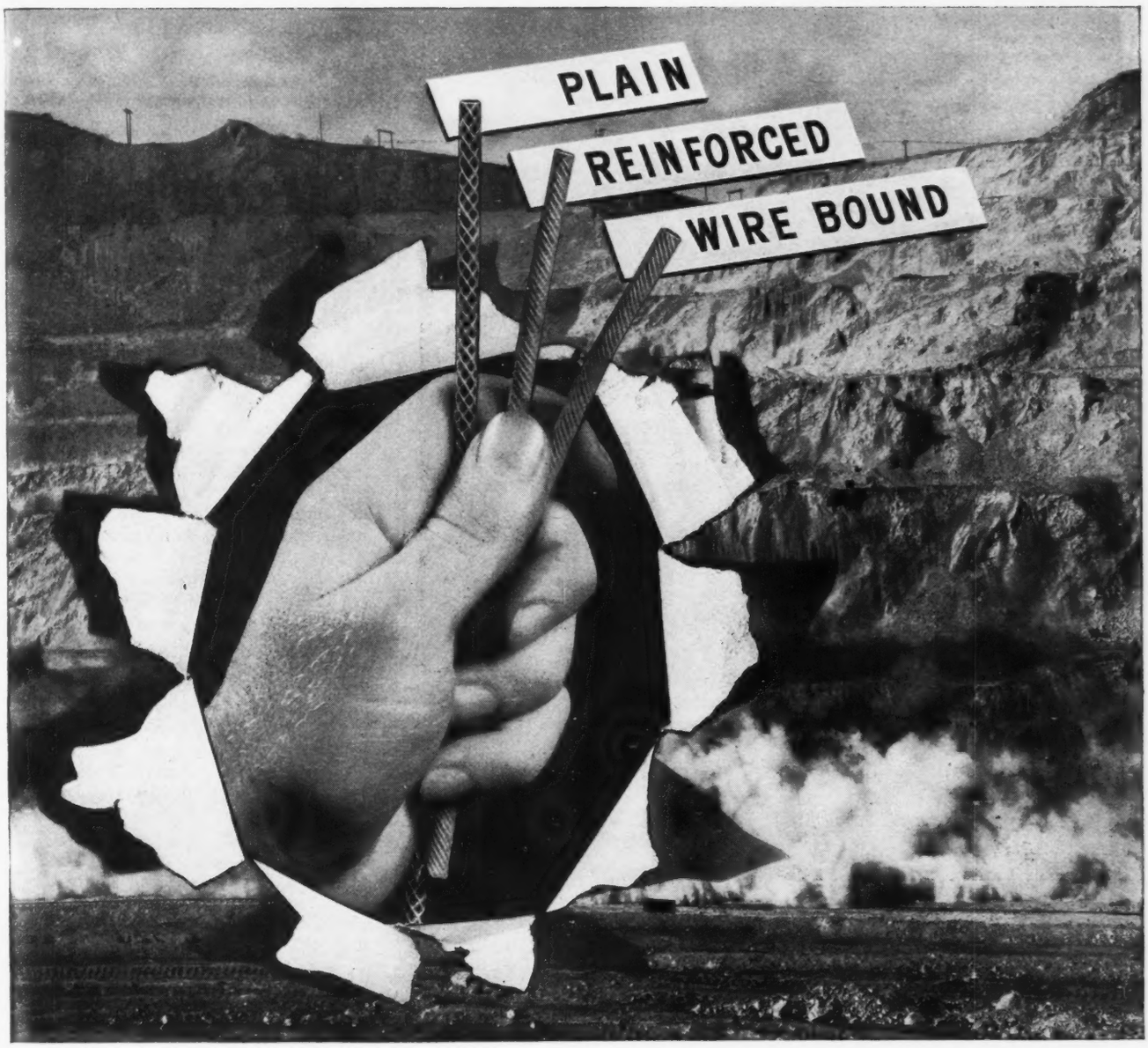

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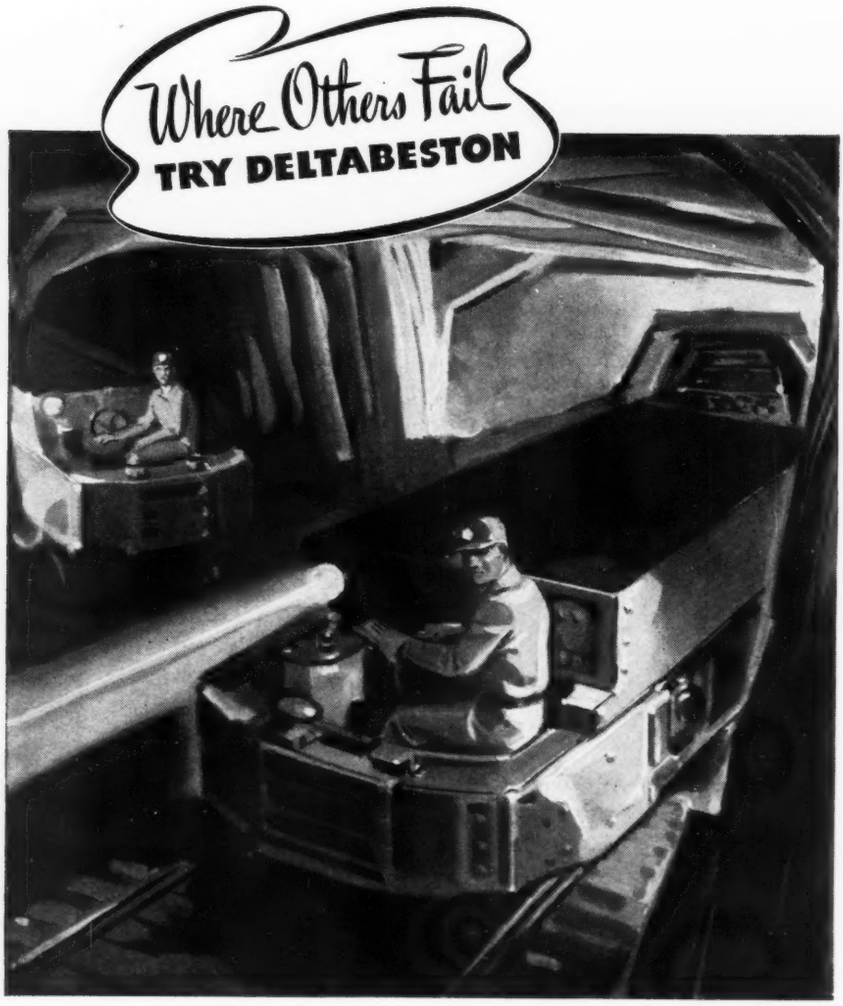

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common type of frother was employed effectively later.

Composite, Medium-Grade, Carbonate Ore—Two parts of selected carbonate ore were mixed with three of rejected waste to make a medium-grade composite sample. This contained appreciable amounts of both the claylike gangue and the iron sulphides and approximately represented lower-grade ore having an ore-dressing problem in the rejection of both clay and iron sulphide.

A sample of reconstructed ore was crushed to minus 10 mesh and tumbled in a ball mill, without balls, for ten minutes to disintegrate the claylike gangue. The ore was then delimed by discarding all minus 325 mesh material as a slime product. The plus 325 mesh sands were ground to all minus 65 mesh and pulped to 30 percent solids in a mechanically agitated flotation cell. The iron sulphides were first floated with Z-6 and pine oil, and then the manganese carbonate was floated, using an emulsion of oleic acid and water stabilized with Emulsion X-1.

Amounts of reagents and results are given in Table V. These results show that in manganese concentrates Nos. 1 and 2, 78.2 percent of the manganese was recovered as a product running 34.9 percent manganese, 2.6 insoluble, and 5.3 iron. This product, if sintered, probably would meet chemical specifications for ferrograde manganese.

Low-Grade Carbonate Ore—To beneficiate the low-grade carbonate ore (14.9 percent Mn) it was necessary, first, to disintegrate and reject the claylike gangue in which the carbonate occurred as large, scattered nodules and stringers. The manganese aggregates were then ground and the iron sulphides were floated and discarded; then the manganese carbonate was floated and recovered.

A large sample of the ore (minus $1\frac{1}{2}$ in.) was tumbled in a ball mill without balls until the gangue was distintegrated. The ore was then screened on 80 mesh and the undersize discarded. The plus 80 mesh was crushed to minus 10 mesh and ground to minus 100 mesh. The ore was then pulped to approximately 30 percent solids in a mechanically agitated flotation cell and conditioned, using 0.9 lb. of sulphuric acid and 1 lb. of sodium silicate per ton. Salt Lake City tap water was used for all test work. The iron sulphides were floated, using 0.1 lb. of potassium ethyl xanthate and 0.05 lb. of pentasol alcohol frother per ton of ore. Next, a bulk concentrate of the manganese carbonate was floated and a rougher tailing discarded; 1.0 lb. of sodium silicate and 1.0 lb. of an aqueous emulsion of oleic acid stabilized with Emulsion X-1 were required per ton of ore. The bulk concentrate was cleaned and re-

Table III—Flotation of Iron Sulphides From High-Grade Carbonate Ore

Product	% Weight	Assay, % Fe	Assay, % Mn	Distribution, % Fe	Distribution, % Mn	Reagent Consumption, Lb. per Ton of Ore: Ethyl Xanthate	Reagent Consumption, Lb. per Ton of Ore: Avirol 80
Sulphide concentrate No. 1	5.2	18.7	21.5	20.5	3.3	0.10	0.30
Sulphide concentrate No. 2	2.3	9.8	30.0	4.7	2.2	0.05	0.10
Sulphide concentrate No. 3	1.8	8.4	31.0	3.1	1.6	0.05	....
Manganese tailing	90.7	3.8	34.9	71.7	92.9	....	....
Calculated heads	100.0	4.8	34.2	100.0	100.0	0.20	0.40

Table IV—Results of Sintering

	Assay, % Mn	Fe	SiO_2	Al_2O_3	Zn	P
Assay of sinter, %	50.1 Min.	5.9 Max.	5.0 Max.	3.9 Max.	No Max.	0.120 Max.
Specifications, Grade B, ferrograde manganese	48.0	7.0	10.0	6.0	1.0	0.18

Table V—Flotation of Medium-Grade Carbonate Ore

Products	% Weight	Assay, % Mn	Assay, % Fe	Assay, % Insol.	Distribution, % Mn	Reagent Consumption Lb. per Ton of Feed: Oleic Acid X-1	Z-6	Pine Oil	Sodium Silicate
Pyrite concentrate No. 1	5.5	5.9	35.6	...	1.3	...	0.1	0.05	...
Pyrite concentrate No. 2	3.6	20.4	14.9	...	3.1	...	0.1	0.05	...
Manganese concentrate No. 1	41.8	35.2	5.3	2.4	61.6	1.5	...	....	2.0
Manganese concentrate No. 2	11.7	33.8	5.4	3.8	16.6	1.5	...	....	...
Siliceous tailing	13.7	11.4	4.5	...	6.6	...	...	....	...
Calculated flotation heads	76.3	27.9	7.8	...	89.2	3.0	0.2	0.10	2.0
Primary slimes	23.7	9.3	4.9	...	10.8	...	...	....	...
Calculated ore	100.0	23.5	7.1	...	100.0	...	...	....	...
Combined manganese concentrates	53.5	34.9	5.3	2.6	78.2				

cleaned to make a final recleaner concentrate. An additional 1.5 lb. of oleic emulsion, 1 lb. of sodium silicate, and 0.05 lb. of pentasol alcohol per ton of ore were used for cleaning and recleaning.

Results showed that 89.4 per cent of the manganese in the flotation feed was recovered in a recleaner concentrate that, when sintered, met the chemical specifications for ferrograde manganese. This recovery represents approximately 70 percent of the manganese in the ore before the claylike gangue is disintegrated and discarded.

In the foregoing work, after simulated log-washing, all minus-80-mesh material was rejected without treatment. Many other complete tests were made wherein a size other than 80 mesh was chosen as the cut-off point for rejection. However, the finer than 80-mesh material was of low grade, and no better over-all results were obtained.

Black Oxide Manganese Ore—The manganese minerals in the oxide ore are psilomelane, pyrolusite, and iron-bearing wad, whereas the gangue minerals are chiefly ocherous clay and mica. The problem involves removal of silica, phosphorus, and iron. Therefore, to concentrate the ore to ferrograde it is necessary to reject not only the silica and phosphorus-bearing ocherous clay but also the iron-bearing wad. The methods studied to beneficiate the ore to ferrograde were disintegration and washing, flotation of manganese, flotation of silica, and tabling. Best results were obtained by tabling.

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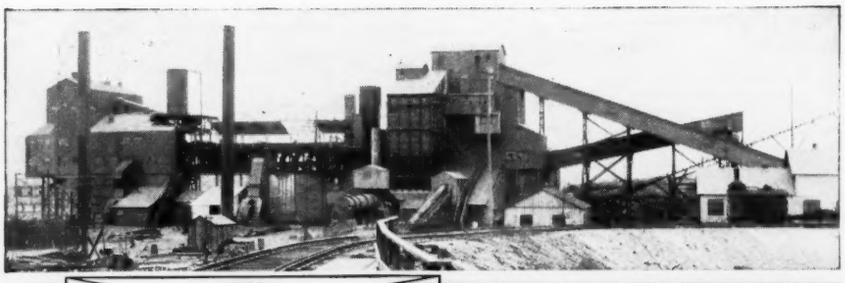

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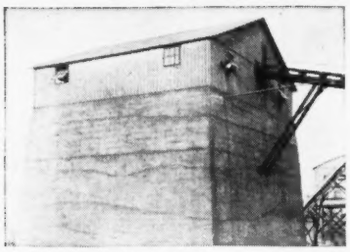

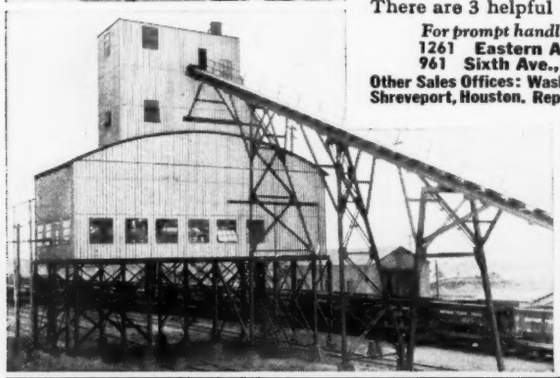

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crushed to minus 10 mesh, ground to minus 65 mesh, and then deslimed. The sands were screen-sized into minus-65-plus-100-mesh, minus-100-plus-200-mesh, and minus-200-mesh fractions. Each sized sand fraction was tabled; the table tailing from each of the two coarser sizes was reground finer and tabled with the next finer size. The slimes, largely wadlike material, were discarded without treatment.

Results showed that by tabling the ore as described and combining the table concentrates, 63.1 percent of the manganese in the ore can be recovered as a product that, when sintered, will meet the chemical specifications for Grade B ferrograde manganese.

Conclusions

Carbonate Ores—1. High-grade, selectively mined ore was found readily amenable to concentration; 96.6 percent of the manganese was recovered as a sand product that, when sintered, met chemical specifications for ferrograde.

2. A medium-grade ore (22.9 percent Mn) made by recombining samples of selected ore and rejects (that were submitted as separate lots) was concentrated to ferrograde; approximately 80 percent of the manganese was recovered as ferrograde sinter.

3. The low-grade ore (14.9 percent Mn) was also concentrated to ferrograde. Much clay and fine sand were rejected before milling, and 89.4 percent of the manganese actually milled was recovered as a final ferrograde sinter. Calculations based upon the ore and clay actually mined show a recovery of approximately 70 percent of the total manganese.

4. The method of beneficiation of low-grade ore consists of (a) log-washing to reject clay and low-grade fine sands, (b) grinding to about 65 mesh, (c) floating and discarding pyritic iron, (d) floating the manganese minerals, and (e) sintering or nodulizing.

5. It is usually necessary to discard the pyritic iron so that the final sinters shall assay less than the 7 percent iron permitted in ferrograde.

6. In the event that the phosphorus or non-pyritic iron contents of the ore should be critical in parts of the deposit not represented by our samples, the possibility of mixing with manganese concentrates of low iron content from other known districts remains as a safeguard.

Black Oxide Ore—1. By tabling sized fractions of the ore, 63.1 percent of the manganese was recovered as a product that, when sintered, met the chemical specifications for ferrograde.

2. Loss of manganese occurring as untreatable slime limited recovery of manganese of ferrograde.

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